



12 September 2016

Federal Communications Commission International Bureau 445 12th Street, SW Washington, D.C. 20554

Re: Engineering Certification of Intelsat

To Whom It May Concern:

This letter certifies that Intelsat is aware that Astronics AeroSat ("Astronics") is planning to seek authorization from the Federal Communications Commission ("FCC") to operate Ku-band transmit/receive earth stations aboard aircraft ("ESAA") terminals with the IS-14 satellite located at 45° W.L., the IS-15 satellite located at 85° E.L., the IS-19 satellite located at 166° E.L., the IS-22 satellite located at 72.1° E.L., the IS-29e satellite located at 50° W.L. and the Galaxy 3C satellite located at 95.05° W.L.. Specifically, we understand that in addition to the previously authorized antenna systems, Astronics seeks to operate the AeroSat HR129 antenna system with these satellites for commercial purposes consistent with the FCC's ESAA rules, including Section 25.227.

Based on the information provided by Astronics, Intelsat understands the technical characteristics of the AeroSat HR129 and Intelsat (i) recognizes that operation of these terminals at the power density levels provided to Intelsat is consistent with existing coordination agreements with all adjacent satellite operators within +/- 6 degrees of orbital separation from IS-14, IS-15, IS-19,IS-22, IS-29e and Galaxy 3C; (ii) acknowledges that the proposed operation of these terminals has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable; and (iii) if the FCC authorizes the operations proposed by Astronics, Intelsat will take into consideration the power density levels associated such operations in all future satellite network coordinations with adjacent satellite operators.

Sincerely,

Dick Evans

Dick Evans

Senior Principal Regulatory Engineer, Spectrum Engineering

Intelsat

Intelsat Corporation

7900 Tysons One Place, McLean, VA 22102-5972 USA www.intelsat.com T+1 703-559-6800

### Link Budget

#### Forward Link Budget eXConnect Terminal HR129 Antenna Type 11.8 deg Lat 6.8 deg Lon EIRP max 41.6 dBW G/T 11.0 dB/K Satellite IS-14 Name -45.0 deg Longitude Hub Earth Station Cologne Lat 50.94 deg Lon 6.96 deg EIRP max 80.0 dBW G/T 37.4 dB/K Signal Waveform DVB-S2 Modulation QPSK Bits per symbol 2 Spread Factor 1 0.75 Coding Rate Overhead Rate 0.92 Channel Spacing 1.20 Spectral Efficiency (Rate/Noise BW) 1.39 bps/Hz 3.62E+07 bps Data Rate 3.92E+07 bps Information Rate (Data + Overhead) Symbol Rate 2.61E+07 Hz Chip Rate (Noise Bandwidth) 2.61E+07 Hz Occupied Bandwidth 3.13E+07 Hz Power Equivelent Bandwidth 3.60E+07 Hz C/N Threshold Uplink Frequency 14.100 GHz Back off 8.1 dB EIRP Spectral Density 33.7 dBW/4kHz Slant Range 40122 km Space Loss, Ls 207.5 dB Pointing Loss, Lpnt 0.0 dB Atmosphere / Weather Loss, La 3.9 dB Radome, Lr 0.0 dB 1.2 dB/K Transponder G/T @ Hub Thermal Noise, C/No 90.3 dBHz 89.8 dBHz C/(No+lo) Satellite Flux Density -95.1 dBW/m2 -92.1 dBW/m2 SFD @ Hub Small Signal Gain (IBO/OBO) 2.0 dB ОВО 1.0 dB Downlink Frequency 11.550 GHz Transponder Sat. EIRP @ Beam Peak 54.0 dBW Transponder Sat. EIRP @ Terminal 53.0 dBW DL PSD Limit 15.0 dBW/4kHz DL PSD @ Beam Peak 14.8 dBW/4kHz Carrier EIRP @ Beam Peak 53.0 dBW Carrier EIRP @ Terminal 52.0 dBW Slant Range 38644 km Space Loss, Ls 205.4 dB Pointing Loss, Lpnt 0.0 dB Atmosphere / Weather Loss, La 0.0 dB Radome, Lr 0.5 dB PCMA Loss 0.0 dB Thermal Noise, C/No 85.7 dBHz C/(No+lo) 80.0 dBHz End to End End to End End to End C/(No+lo) 79.6 dBHz End to End C/(No+Io)

1.0 dB

4.4 dB

0.0 dB

Implementation Loss

Link Margin

End to End C/N w/ Imp Loss

Implementation Loss

Link Margin

End to End C/N w/ Imp Loss

Return Link Budget		
eXConnect Terminal		
Antenna Type	HR129	
Lat	11.8 deg	
Lon	6.8 deg	
EIRP max	41.6 dBW	
G/T Satellite	11.0 dB/K	
Name	IS-14	
Longitude	-45.0 deg	
Hub Earth Station	45.0 deg	
Site	Cologne	
Lat	50.94 deg	
Lon	6.96 deg	
EIRP max	80.0 dBW	
G/T	37.4 dB/K	
Signal	,	
Waveform	iDirect	
Modulation	BPSK	
Bits per symbol	1	
Spread Factor	2	
Coding Rate	0.50	
Overhead Rate	0.74	
Channel Spacing	1.20	
Spectral Efficiency (Rate/Noise BW)	0.18 bps/Hz	
Data Rate	1.23E+06 bps	
Information Rate (Data + Overhead)	1.67E+06 bps	
Symbol Rate	3.34E+06 Hz	
Chip Rate (Noise Bandwidth)	6.67E+06 Hz	
Occupied Bandwidth	8.00E+06 Hz	
Power Equivelent Bandwidth	1.88E+05 Hz	
C/N Threshold	-2.3 dB	
Uplink	210 40	
Frequency	14.202 GHz	
Back off	0.0 dB	
EIRP Spectral Density	9.4 dBW/4kH	
Slant Range	38644 km	
Space Loss, Ls	207.2 dB	
Pointing Loss, Lpnt	0.1 dB	
Atmosphere / Weather Loss, La	0.0 dB	
Radome, Lr	0.5 dB	
Transponder G/T @ Terminal	7.2 dB/K	
Thermal Noise, C/No	69.6 dBHz	
C/(No+lo)	69.1 dBHz	
Satellite		
Flux Density	-121.7 dBW/m2	
SFD @ Terminal	-89.8 dBW/m2	
Small Signal Gain (IBO/OBO)	2.0 dB	
ОВО	29.9 dB	
Downlink		
Frequency	11.652 GHz	
Transponder Sat. EIRP @ Beam Peak	54.0 dBW	
Transponder Sat. EIRP @ Hub	47.0 dBW	
DL PSD Limit	15.0 dBW/4kH	
DL PSD @ Beam Peak	-8.2 dBW/4kH	
Carrier EIRP @ Beam Peak	24.1 dBW	
Carrier EIRP @ Hub	17.1 dBW	
Slant Range	40122 km	
Space Loss, Ls	205.8 dB	
Pointing Loss, Lpnt	0.0 dB	
Atmosphere / Weather Loss, La	4.3 dB	
Radome, Lr	0.0 dB	
PCMA Loss	0.0 dB	
Thermal Noise, C/No	72.9 dBHz	
Thermal Noise, C/No C/(No+Io)	72.9 dBHz 69.5637 dBHz	

66.3 dBHz

0.0 dB

-1.9 dB

0.4 dB





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Based on the information provided by Astronics, Intelsat understands the technical characteristics of the AeroSat HR129 and Intelsat (i) recognizes that operation of these terminals at the power density levels provided to Intelsat is consistent with existing coordination agreements with all adjacent satellite operators within +/- 6 degrees of orbital separation from IS-14, IS-15, IS-19,IS-22, IS-29e and Galaxy 3C; (ii) acknowledges that the proposed operation of these terminals has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable; and (iii) if the FCC authorizes the operations proposed by Astronics, Intelsat will take into consideration the power density levels associated such operations in all future satellite network coordinations with adjacent satellite operators.

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Based on the information provided by Astronics, Intelsat understands the technical characteristics of the AeroSat HR6400 and Intelsat (i) recognizes that operation of these terminals at the power density levels provided to Intelsat is consistent with existing coordination agreements with all adjacent satellite operators within +/- 6 degrees of orbital separation from IS-14, IS-15, IS-19,IS-22, IS-29e and Galaxy 3C; (ii) acknowledges that the proposed operation of these terminals has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable; and (iii) if the FCC authorizes the operations proposed by Astronics, Intelsat will take into consideration the power density levels associated such operations in all future satellite network coordinations with adjacent satellite operators.

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Intelsat

## **Link Budgets**

## Forward Link Budget

## Return Link Budget (Link 1)

Flitestream Terminal		Flitestream Terminal	
Site	Jordan	Site	Armenia
Antenna Type	HR6400	Antenna Type	HR6400
Lat	29.5 deg	Lat	29.5 deg
Lon	35.4 deg	Lon	35.4 deg
G/T	12.3 dB/K	EIRP max	45.0 dBW
Satellite		Satellite	
Name	IS-15	Name	IS-15
Transponder	K12	Transponder	K12
Longitude	85.2 deg	Longitude	85.2 deg
Hub Earth Station	22.2 226	Hub Earth Station	
Site	Cyprus	Site	Cyprus
Lat	34.859 deg	Lat	34.859 deg
Lon	33.383 deg	Lon	33.383 deg
EIRP max	80.0 dBW	G/T	39.0 dB/K
Signal		Signal	
Waveform	DVB-S2		DirectRL-SF4
Modulation	QPSK	Modulation	BPSK
Bits per symbol	2	Bits per symbol	1
Spread Factor	1	Spread Factor	4
Coding Rate	0.66670	Coding Rate	0.43
Overhead Rate	0.93986	Overhead Rate	0.68
Channel Spacing	1.20	Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW		Spectral Efficiency (Rate/Noise BW	
Data Rate	2.10E+06 bps	Data Rate	4.86E+05 bps
Information Rate (Data + Overhead	•	Information Rate (Data + Overhead	·
Symbol Rate	1.67E+06 Hz	Symbol Rate	1.67E+06 Hz
Chip Rate (Noise Bandwidth)	1.67E+06 Hz	Chip Rate (Noise Bandwidth)	6.67E+06 Hz
Occupied Bandwidth	2.00E+06 Hz	Occupied Bandwidth	8.00E+06 Hz
C/N Threshold	3.5 dB	C/N Threshold	-5.0 dB
Uplink	3.5 0.5	Uplink	-3.0 ub
Frequency	14.110000 GHz	Frequency	14.110000 GHz
	Automatic Uplink Power Control		Automatic Uplink Power Control
Back off	24.6 dB	Back off	0.0 dB
EIRP Spectral Density	29.2 dBW/4kHz	EIRP Spectral Density	12.8 dBW/4kHz
Slant Range	39315 km	Slant Range	38944 km
Space Loss, Ls	207.3 dB	Space Loss, Ls	207.2 dB
Pointing Loss, Lpnt	0.0 dB	Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	2.4 dB	Atmosphere / Weather Loss, La	0.1 dB 0.0 dB
Radome, Lr	0.0 dB	Radome, Lr	0.0 dB
Transponder G/T @ Hub	1.0 dB/K	Transponder G/T @ Terminal	2.0 dB/K
Thermal Noise, C/No	75.3 dBHz	Thermal Noise, C/No	68.3 dBHz
	74.8 dBHz	C/(No+lo)	67.8 dBHz
C/(No+lo) Satellite	74.6 UBRZ	Satellite	07.8 UBITZ
Flux Density	-109.9 dBW/m2	Flux Density	-117.0 dBW/m2
SFD @ Hub		**************************************	
_	-95.8 dBW/m2	SFD @ Terminal	-96.8 dBW/m2
Small Signal Gain (IBO/OBO)	2.1 dB	Small Signal Gain (IBO/OBO)	2.1 dB
OBO Downlink	12.0 dB	OBO Downlink	18.1 dB
	12 C00000 CUs		12 C00000 CUs
· ·	12.600000 GHz	Frequency	12.600000 GHz
Transponder Sat. EIRP @ Beam Pe	50.8 dBW	Transponder Sat. EIRP @ Beam Pe	
Transponder Sat. EIRP @ Terminal	46.8 dBW	Transponder Sat. EIRP @ Hub	46.8 dBW
DL PSD Limit	16.0 dBW/4kHz	DL PSD Limit	16.0 dBW/4kHz
DL PSD @ Beam Peak	12.6 dBW/4kHz	DL PSD @ Beam Peak	-0.4 dBW/4kHz
Carrier EIRP @ Beam Peak	38.8 dBW	Carrier EIRP @ Beam Peak	31.8 dBW
Carrier EIRP @ Terminal	34.8 dBW	Carrier EIRP @ Hub	27.8 dBW
Slant Range	38944 km	Slant Range	39315 km
Space Loss, Ls	206.3 dB	Space Loss, Ls	206.3 dB
Pointing Loss, Lpnt	0.1 dB	Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB	Atmosphere / Weather Loss, La	3.5 dB
		Radome, Lr	0.0 dB
Radome, Lr	0.0 dB	00144	0.6 '-
PCMA Loss	0.0 dB	PCMA Loss	0.0 dB
PCMA Loss Thermal Noise, C/No	0.0 dB 69.3 dBHz	Thermal Noise, C/No	85.6 dBHz
PCMA Loss Thermal Noise, C/No C/(No+lo)	0.0 dB	Thermal Noise, C/No C/(No+lo)	
PCMA Loss Thermal Noise, C/No C/(No+lo) End to End	0.0 dB 69.3 dBHz 69.0 dBHz	Thermal Noise, C/No C/(No+lo) End to End	85.6 dBHz 85.1 dBHz
PCMA Loss Thermal Noise, C/No C/(No+lo) End to End End to End C/(No+lo)	0.0 dB 69.3 dBHz 69.0 dBHz	Thermal Noise, C/No C/(No+lo) End to End End to End C/(No+lo)	85.6 dBHz 85.1 dBHz 67.7 dBHz
PCMA Loss Thermal Noise, C/No C/(No+lo) End to End End to End C/(No+lo) Implementation Loss	0.0 dB 69.3 dBHz 69.0 dBHz 68.0 dBHz 1.0 dB	Thermal Noise, C/No C/(No+Io) End to End End to End C/(No+Io) Implementation Loss	85.6 dBHz 85.1 dBHz 67.7 dBHz 0.0 dB
PCMA Loss Thermal Noise, C/No C/(No+lo) End to End End to End C/(No+lo)	0.0 dB 69.3 dBHz 69.0 dBHz	Thermal Noise, C/No C/(No+lo) End to End End to End C/(No+lo)	85.6 dBHz 85.1 dBHz 67.7 dBHz

### Forward Link Budget

### Return Link Budget (Link 2)

Site	Jordan
Antenna Type	HR6400
at	29.5 deg
.on	35.4 deg
G/T	12.5 dB/K
atellite	
ame	IS-15
ransponder	K12
ongitude	85.2 deg
ub Earth Station	
ite	Cyprus
at	34.859 deg
.on	33.383 deg
IRP max	80.0 dBW
ignal	
Vaveform	DVR-S2

Signal	
Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.33
Overhead Rate	0.92
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW	0.61 bps/Hz
Data Rate	2.80E+06 bps
Information Rate (Data + Overhead	3.06E+06 bps
Symbol Rate	4.58E+06 Hz
Chip Rate (Noise Bandwidth)	4.58E+06 Hz
Occupied Bandwidth	5.50E+06 Hz
C/N Threshold	-0.8 dB
Unlink	

C/N Inresnoia	-0.8 aB
Uplink	
Frequency	14.160000 GHz
Power Control Mode	Automatic Uplink Power Control
Back off	24.6 dB
EIRP Spectral Density	24.8 dBW/4kHz
Slant Range	39315 km
Space Loss, Ls	207.4 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	2.4 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	1.0 dB/K
Thermal Noise, C/No	75.3 dBHz
C/(No+lo)	74.8 dBHz
Satellite	

Satellite	
Flux Density	-109.9 dBW/m2
SFD @ Hub	-95.8 dBW/m2
Small Signal Gain (IBO/OBO)	2.1 dB
ОВО	12.0 dB

OBO	12.0	dB
Downlink		
Frequency	12.600000	GHz
Transponder Sat. EIRP @ Beam Pe	50.8	dBW
Transponder Sat. EIRP @ Terminal	46.8	dBW
DL PSD Limit	16.0	dBW/4kHz
DL PSD @ Beam Peak	8.2	dBW/4kHz
Carrier EIRP @ Beam Peak	38.8	dBW
Carrier EIRP @ Terminal	34.8	dBW
Slant Range	38939	km
Space Loss, Ls	206.3	dB
Pointing Loss, Lpnt	0.1	dB
Atmosphere / Weather Loss, La	0.0	dB
Radome, Lr	0.0	dB
PCMA Loss	0.0	dB
Thermal Noise, C/No	69.6	dBHz
C/(No+lo)	69.5	dBHz

Lilu to Lilu	
End to End C/(No+Io)	68.4 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	0.8 dB
Link Margin	1.6 dB

Flitestream Terminal	
Site	Armenia
Antenna Type	HR6400
Lat	29.5 deg
Lon	35.4 deg
EIRP max	45.0 dBW

Satellite	
Name	IS-15
Transponder	K12
Longitude	85.2 deg

Hub Earth Station	
Site	Cyprus
Lat	34.859 deg
Lon	33.383 deg
G/T	39.0 dB/K

Signal	
Waveform	iDirectRL-SF4
Modulation	BPSK
Bits per symbol	1
Spread Factor	1
Coding Rate	0.53
Overhead Rate	0.72
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BV	0.38 bps/Hz
Data Rate	1.91E+06 bps
Information Rate (Data + Overhea	2.67E+06 bps
Symbol Rate	5.00E+06 Hz
Chip Rate (Noise Bandwidth)	5.00E+06 Hz
Occupied Bandwidth	6.00E+06 Hz
C/N Threshold	1.1 dB
Unlink	

c/ 14 TITI CONTOIN	111 00
Uplink	
Frequency	14.160000 GHz
Power Control Mode	Automatic Uplink Power Control
Back off	0.0 dB
EIRP Spectral Density	14.0 dBW/4kHz
Slant Range	38939 km
Space Loss, Ls	207.3 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
Transponder G/T @ Terminal	2.0 dB/K
Thermal Noise, C/No	68.2 dBHz
C/(No+lo)	68.1 dBHz
A . 100.	

Satellite			
Flux Density		-117.0	dBW/m2
SFD @ Term		-96.8	dBW/m2
Small Signal	Gain (IBO/OBO)	2.1	dB
ОВО		18.1	dB

Downlink	
Frequency	12.642750 GHz
Transponder Sat. EIRP @ Beam Pe	50.8 dBW
Transponder Sat. EIRP @ Hub	46.8 dBW
DL PSD Limit	16.0 dBW/4kHz
DL PSD @ Beam Peak	0.8 dBW/4kHz
Carrier EIRP @ Beam Peak	31.8 dBW
Carrier EIRP @ Hub	27.8 dBW
Slant Range	39315 km
Space Loss, Ls	206.4 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.5 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	85.5 dBHz
C/(No+lo)	84.9 dBHz

End to End	
End to End C/(No+Io)	68.1 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	1.1 dB
Link Margin	0.0 dB

Forward Link Bu	udget	Return Link Bud	get
eXConnect Terminal		eXConnect Terminal	
Antenna Type	HR129	Antenna Type	HR129
Lat	14.9 deg	Lat	14.9 deg
Lon	53.0 deg	Lon	53.0 deg
EIRP max	42.5 dBW	EIRP max	42.5 dBW
G/T	11.3 dB/K	G/T	11.3 dB/K
Satellite		Satellite	
Name	IS-15	Name	IS-15
Longitude	85.2 deg	Longitude	85.2 deg
Hub Earth Station		Hub Earth Station	
Site	Cyprus	Site	Cyprus
Lat	34.92 deg	Lat	34.92 deg
Lon	33.64 deg	Lon	33.64 deg
EIRP max	80.0 dBW	EIRP max	80.0 dBW
G/T	37.3 dB/K	G/T	37.3 dB/K
Signal	,	Signal	
Waveform	DVB-S2	Waveform	iDirect
Modulation	QPSK	Modulation	BPSK
	2		1
Bits per symbol		Bits per symbol	
Spread Factor	1	Spread Factor	2
Coding Rate	0.50	Coding Rate	0.67
Overhead Rate	0.83	Overhead Rate	0.72
Channel Spacing	1.20	Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.83 bps/Hz	Spectral Efficiency (Rate/Noise BW)	0.24 bps/Hz
Data Rate	1.38E+07 bps	Data Rate	1.61E+06 bps
Information Rate (Data + Overhead)	1.67E+07 bps	Information Rate (Data + Overhead)	2.22E+06 bps
Symbol Rate	1.67E+07 Hz	Symbol Rate	3.34E+06 Hz
Chip Rate (Noise Bandwidth)	1.67E+07 Hz	Chip Rate (Noise Bandwidth)	6.67E+06 Hz
Occupied Bandwidth	2.00E+07 Hz	Occupied Bandwidth	8.00E+06 Hz
	3.28E+07 Hz	Power Equivelent Bandwidth	7.62E+05 Hz
Power Equivelent Bandwidth		· ·	
C/N Threshold	0.9 dB	C/N Threshold	-1.2 dB
Uplink		Uplink	
Frequency	14.048 GHz	Frequency	14.048 GHz
Back off	14.8 dB	Back off	0.0 dB
EIRP Spectral Density	29.0 dBW/4kHz	EIRP Spectral Density	10.2 dBW/4kHz
Slant Range	39297 km	Slant Range	37136 km
Space Loss, Ls	207.3 dB	Space Loss, Ls	206.8 dB
Pointing Loss, Lpnt	0.0 dB	Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.4 dB	Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB	Radome, Lr	0.5 dB
Transponder G/T @ Hub	1.7 dB/K	Transponder G/T @ Terminal	4.7 dB/K
Thermal Noise, C/No	84.8 dBHz	Thermal Noise, C/No	68.4 dBHz
C/(No+lo)	84.3 dBHz	C/(No+lo)	67.9 dBHz
Satellite		Satellite	
Flux Density	-101.1 dBW/m2	Flux Density	-120.5 dBW/m2
SFD @ Hub	-92.7 dBW/m2	SFD @ Terminal	-95.7 dBW/m2
Small Signal Gain (IBO/OBO)	1.5 dB	Small Signal Gain (IBO/OBO)	1.5 dB
ОВО	6.9 dB	ОВО	23.3 dB
Downlink		Downlink	
Frequency	12.538 GHz	Frequency	12.538 GHz
Transponder Sat. EIRP @ Beam Peak	52.7 dBW	Transponder Sat. EIRP @ Beam Peak	52.7 dBW
Transponder Sat. EIRP @ Terminal	51.7 dBW	Transponder Sat. EIRP @ Hub	48.7 dBW
DL PSD Limit	16.0 dBW/4kHz	DL PSD Limit	16.0 dBW/4kHz
DL PSD @ Beam Peak	9.6 dBW/4kHz	DL PSD @ Beam Peak	-2.8 dBW/4kHz
-	•		·
Carrier EIRP @ Beam Peak	45.8 dBW	Carrier EIRP @ Beam Peak	29.4 dBW
Carrier EIRP @ Terminal	44.8 dBW	Carrier EIRP @ Hub	25.4 dBW
Slant Range	37136 km	Slant Range	39297 km
Space Loss, Ls	205.8 dB	Space Loss, Ls	206.3 dB
Pointing Loss, Lpnt	0.0 dB	Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB	Atmosphere / Weather Loss, La	4.6 dB
Radome, Lr	0.5 dB	Radome, Lr	0.0 dB
PCMA Loss	0.0 dB	PCMA Loss	0.0 dB
Thermal Noise, C/No	78.4 dBHz	Thermal Noise, C/No	80.4 dBHz
C/(No+lo)	76.2 dBHz	C/(No+lo)	76.3218 dBHz
	70.2 UBHZ	End to End	/U.3410 UDD4
End to End	75.6 12.1		67.1.100
End to End C/(No+lo)	75.6 dBHz	End to End C/(No+Io)	67.4 dBHz
Implementation Loss	1.0 dB	Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	2.3 dB	End to End C/N w/ Imp Loss	-0.9 dB
Link Margin	1.4 dB	Link Margin	0.3 dB

1.4 dB

Link Margin

Link Margin

0.3 dB

# 12. IS-29E





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Re: Engineering Certification of Intelsat

To Whom It May Concern:

This letter certifies that Intelsat is aware that Astronics AeroSat ("Astronics") is planning to seek authorization from the Federal Communications Commission ("FCC") to operate Ku-band transmit/receive earth stations aboard aircraft ("ESAA") terminals with the IS-14 satellite located at 45° W.L., the IS-15 satellite located at 85° E.L., the IS-19 satellite located at 166° E.L., the IS-22 satellite located at 72.1° E.L., the IS-29e satellite located at 50° W.L. and the Galaxy 3C satellite located at 95.05° W.L.. Specifically, we understand that in addition to the previously authorized antenna systems, Astronics seeks to operate the AeroSat HR129 antenna system with these satellites for commercial purposes consistent with the FCC's ESAA rules, including Section 25.227.

Based on the information provided by Astronics, Intelsat understands the technical characteristics of the AeroSat HR129 and Intelsat (i) recognizes that operation of these terminals at the power density levels provided to Intelsat is consistent with existing coordination agreements with all adjacent satellite operators within +/- 6 degrees of orbital separation from IS-14, IS-15, IS-19,IS-22, IS-29e and Galaxy 3C; (ii) acknowledges that the proposed operation of these terminals has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable; and (iii) if the FCC authorizes the operations proposed by Astronics, Intelsat will take into consideration the power density levels associated such operations in all future satellite network coordinations with adjacent satellite operators.

Sincerely,

Dick Evans

Dick Evans

Senior Principal Regulatory Engineer, Spectrum Engineering

Intelsat

Intelsat Corporation

7900 Tysons One Place, McLean, VA 22102-5972 USA www.intelsat.com T+1 703-559-6800



12 September 2016

Federal Communications Commission International Bureau 445 12th Street, SW Washington, D.C. 20554

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Based on the information provided by Astronics, Intelsat understands the technical characteristics of the AeroSat HR6400 and Intelsat (i) recognizes that operation of these terminals at the power density levels provided to Intelsat is consistent with existing coordination agreements with all adjacent satellite operators within +/- 6 degrees of orbital separation from IS-14, IS-15, IS-19,IS-22, IS-29e and Galaxy 3C; (ii) acknowledges that the proposed operation of these terminals has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable; and (iii) if the FCC authorizes the operations proposed by Astronics, Intelsat will take into consideration the power density levels associated such operations in all future satellite network coordinations with adjacent satellite operators.

Sincerely,

Dick Evans

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Senior Principal Regulatory Engineer, Spectrum Engineering

Intelsat

## **Link Budgets**

#### Forward Link Budget

Fiitestream Terminai	
Site	
Antenna Type	HR6400
Lat Lon G/T	37.4 deg
Lon	-97.2 deg
G/T	12.1 dB/K

#### Satellite Name IS-29 Longitude -50.0 deg

Hub Earth Station	
Site	ountainside
Lat	39.599 deg
Lon	-77.757 deg
EIRP max	80.0 dBW

Signal	
Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.89
Overhead Rate	0.95
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise B\	1.69 bps/Hz
Data Rate	7.59E+07 bps
Information Rate (Data + Overhea	8.00E+07 bps
Symbol Rate	4.50E+07 Hz
Chip Rate (Noise Bandwidth)	4.50E+07 Hz
Occupied Bandwidth	5.40E+07
C/N Threshold	6.6 dB

Uplink	
Frequency	14.000000 GHz
Power Control Mode	Automatic Uplink Power Control
Back off	14.0 dB
EIRP Spectral Density	25.5 dBW/4kHz
Slant Range	38102 km
Space Loss, Ls	207.0 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.1 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	16.0 dB/K
Thermal Noise, C/No	100.5 dBHz
C/(No+lo)	100 0 dBHz

C/(No+lo)	100.0 dBHz
Satellite	
Flux Density	-99.7 dBW/m2
SFD @ Hub	-89.0 dBW/m2
Small Signal Gain (IBO/OBO)	2.0 dB
ОВО	8.7 dB

Downlink	
Frequency	12.000000 GHz
Transponder Sat. EIRP @ Beam Pe	62.2 dBW
Transponder Sat. EIRP @ Termina	61.2 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	13.0 dBW/4kHz
Carrier EIRP @ Beam Peak	53.5 dBW
Carrier EIRP @ Terminal	52.5 dBW
Slant Range	39091 km
Space Loss, Ls	205.9 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	87.2 dBHz
C/(No+lo)	85.7 dBHz
End to End	

Liid to Liid	
End to End C/(No+Io)	85.5 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	8.0 dB
Link Margin	1.4 dB

#### Return Link Budget (Link 1)

#### Flitestream Terminal

Name	IS-29
Satellite	
EIRP max	44.9 dBW
Lon	-97.2 deg
Lat	37.4 deg
Antenna Type	HR6400
Site	

# Longitude Hub Earth Station

TIGO Editili Otation	
Site	∕lountainside
Lat	39.599 deg
Lon	-77.757 deg
G/T	40.4 dB/K

-50.0 deg

Signai	
Waveform	iDirect
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.86
Overhead Rate	0.87
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise B\	1.49 bps/Hz
Data Rate	9.93E+06 bps
Information Rate (Data + Overhea	1.14E+06 bps
Symbol Rate	6.66E+06 Hz
Chip Rate (Noise Bandwidth)	6.66E+06 Hz
Occupied Bandwidth	7.99E+06 Hz
C/N Threshold	7.5 dB

#### Uplink Frequency 14.000000 GHz Power Control Mode Back off Automatic Uplink Power Control 2.6 dB EIRP Spectral Density 10.1 dBW/4kHz Slant Range 39091 km Space Loss, Ls 207.2 dB 0.1 dB 0.0 dB Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr 0.0 dB 0.0 dB 15.4 dB/K 79.0 dBHz 78.7 dBHz Transponder G/T @ Terminal Thermal Noise, C/No C/(No+lo) Satellite

Flux Density	-117.8 dBW/m2
SFD @ Terminal	-103.4 dBW/m2
Small Signal Gain (IBO/OBO)	2.0 dB
ОВО	12.5 dB

### Downlink

20101111111		
Frequency	12.000000	GHz
Transponder Sat. EIRP @ Beam Pe	60.0	dBW
Transponder Sat. EIRP @ Hub	60.0	dBW
DL PSD Limit	13.0	dBW/4kHz
DL PSD @ Beam Peak	12.5	dBW/4kHz
Carrier EIRP @ Beam Peak	44.8	dBW
Carrier EIRP @ Hub	44.8	dBW
Slant Range	38102	km
Space Loss, Ls	205.6	dB
Pointing Loss, Lpnt	0.0	dB
Atmosphere / Weather Loss, La	3.9	dB
Radome, Lr	0.0	dB
PCMA Loss	0.0	dB
Thermal Noise, C/No	104.2	dBHz
C/(No+lo)	85 O	dBH2

## C/(No+lo) End to End

End to End C/(No+Io)	77.8 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	9.5 dB
Link Margin	2.0 dB

### Forward Link Budget

## Return Link Budget (Link 1)

			_	
ы	itesti	ream	Term	ıına

Site	
Antenna Type	HR6400
Lat	52.0 deg
Antenna Type Lat Lon G/T	-35.0 deg
G/T	12.1 dB/K

## Satellite

Sutcinte		
Name	IS-29	
Longitude	-50.0 deg	

### Hub Earth Station

Site	ountainside
Lat	39.599 deg
Lon	-77.757 deg
FIRP max	80.0 dBW

## Signal

Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.67
Overhead Rate	0.94
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise B\	1.26 bps/Hz
Data Rate	5.66E+06 bps
Information Rate (Data + Overhea	6.00E+07 bps
Symbol Rate	4.50E+07 Hz
Chip Rate (Noise Bandwidth)	4.50E+07 Hz
Occupied Bandwidth	5.40E+07
C/N Threshold	3.5 dB

## Uplink

Uplink	
Frequency	14.000000 GHz
Power Control Mode	Automatic Uplink Power Control
Back off	12.5 dB
EIRP Spectral Density	27.0 dBW/4kHz
Slant Range	38102 km
Space Loss, Ls	207.0 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.1 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	16.0 dB/K
Thermal Noise, C/No	102.0 dBHz
C/(No+lo)	101.3 dBHz

## Satellite

Flux Density	-99.7 dBW/m2
SFD @ Hub	-89.0 dBW/m2
Small Signal Gain (IBO/OBO)	2.0 dB
ОВО	7.2 dB

## Downlink

Frequency	12.000000 GHz
Transponder Sat. EIRP @ Beam Pe	56.1 dBW
Transponder Sat. EIRP @ Termina	55.1 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	8.4 dBW/4kHz
Carrier EIRP @ Beam Peak	48.9 dBW
Carrier EIRP @ Terminal	47.9 dBW
Slant Range	38711 km
Space Loss, Ls	205.8 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	82.7 dBHz
C/(No+lo)	82.2 dBHz

### End to End

End to End C/(No+Io)	82.1 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	4.6 dB
Link Margin	1.1 dB

## Flitestream Terminal

Site	
Antenna Type	HR6400
Lat	52.0 deg
Lon	-35.0 deg
EIRP max	44.9 dBW

#### Satellite

Name	IS-29
Longitude	-50.0 deg

### Hub Earth Station

Site	∕lountainside
Lat	39.599 deg
Lon	-77.757 deg
G/T	40.4 dB/K

### Signal

Waveform	iDirect
Modulation	BPSK
Bits per symbol	1
Spread Factor	2
Coding Rate	0.67
Overhead Rate	0.72
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise B\	0.24 bps/Hz
Data Rate	1.61E+06 bps
Information Rate (Data + Overhea	2.23E+06 bps
Symbol Rate	3.33E+06 Hz
Chip Rate (Noise Bandwidth)	6.66E+06 Hz
Occupied Bandwidth	7.99E+06 Hz
C/N Threshold	-1.2 dB

### Uplink

Oplink	
Frequency	14.000000 GHz
Power Control Mode	Automatic Uplink Power Control
Back off	0.0 dB
EIRP Spectral Density	14.7 dBW/4kHz
Slant Range	37390 km
Space Loss, Ls	206.8 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
Transponder G/T @ Terminal	0.2 dB/K
Thermal Noise, C/No	68.8 dBHz
C/(No+Io)	68.7 dBHz

### Satellite

Flux Density	-117.8 dBW/m2
SFD @ Terminal	-88.2 dBW/m2
Small Signal Gain (IBO/OBO)	2.0 dB
ОВО	25.5 dB

## Downlink

Frequency	12.000000	GHz
Transponder Sat. EIRP @ Beam Pe	60.0	dBW
Transponder Sat. EIRP @ Hub	60.0	dBW
DL PSD Limit	13.0	dBW/4kHz
DL PSD @ Beam Peak	2.3	dBW/4kHz
Carrier EIRP @ Beam Peak	34.6	dBW
Carrier EIRP @ Hub	34.6	dBW
Slant Range	38102	km
Space Loss, Ls	205.6	dB
Pointing Loss, Lpnt	0.0	dB
Atmosphere / Weather Loss, La	3.9	dB
Radome, Lr	0.0	dB
PCMA Loss	0.0	dB
Thermal Noise, C/No	94.0	dBHz
C/(No+lo)	84.5	dBHz

### End to End

End to End C/(No+Io)	68.6 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	0.4 dB
Link Margin	1.6 dB

### Forward Link Budget

## Return Link Budget (Link 1)

|--|

Site	
Antenna Type	HR6400
Lat Lon G/T	25.4 deg
Lon	-80.1 deg
G/T	12.1 dB/K

## Satellite

Sutcinte	
Name	IS-29
Longitude	-50.0 deg

### Hub Earth Station

Site	ountainside
Lat	39.599 deg
Lon	-77.757 deg
FIRP max	80.0 dBW

## Signal

Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.60
Overhead Rate	0.94
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise B\	1.13 bps/Hz
Data Rate	5.08E+06 bps
Information Rate (Data + Overhea	5.40E+06 bps
Symbol Rate	4.50E+06 Hz
Chip Rate (Noise Bandwidth)	4.50E+06 Hz
Occupied Bandwidth	5.40E+07
C/N Threshold	2.7 dB

## Uplink

Uplink	
Frequency	14.000000 GHz
Power Control Mode	Automatic Uplink Power Control
Back off	6.3 dB
EIRP Spectral Density	33.2 dBW/4kHz
Slant Range	38102 km
Space Loss, Ls	207.0 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.1 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	16.0 dB/K
Thermal Noise, C/No	108.2 dBHz
C/(No+lo)	105.8 dBHz

## Satellite

Flux Density	-99.7 dBW/m2
SFD @ Hub	-89.0 dBW/m2
Small Signal Gain (IBO/OBO)	2.0 dB
ОВО	1.0 dB

## Downlink

Frequency	12.000000 GHz
Transponder Sat. EIRP @ Beam Pe	48.1 dBW
Transponder Sat. EIRP @ Termina	47.1 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	6.6 dBW/4kHz
Carrier EIRP @ Beam Peak	47.1 dBW
Carrier EIRP @ Terminal	46.1 dBW
Slant Range	37390 km
Space Loss, Ls	205.5 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	81.2 dBHz
C/(No+lo)	80.8 dBHz

### End to End

End to End C/(No+Io)	80.8 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	3.3 dB
Link Margin	59.0 dB

## Flitestream Terminal

Site	
Antenna Type	HR6400
Lat	52.0 deg
Lon	-35.0 deg
EIRP max	44.9 dBW

#### Satellite

Name	IS-29
Longitude	-50.0 deg

### Hub Earth Station

Site	∕lountainside
Lat	39.599 deg
Lon	-77.757 deg
G/T	40.4 dB/K

### Signal

Waveform	iDirect
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.86
Overhead Rate	0.87
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise B\	1.49 bps/Hz
Data Rate	9.93E+06 bps
Information Rate (Data + Overhea	1.14E+07 bps
Symbol Rate	6.66E+06 Hz
Chip Rate (Noise Bandwidth)	6.66E+06 Hz
Occupied Bandwidth	7.99E+06 Hz
C/N Threshold	7.5 dB

### Uplink

Uplink	
Frequency	14.000000 GHz
Power Control Mode	Automatic Uplink Power Control
Back off	2.0 dB
EIRP Spectral Density	10.7 dBW/4kHz
Slant Range	38711 km
Space Loss, Ls	207.1 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
Transponder G/T @ Terminal	14.8 dB/K
Thermal Noise, C/No	79.1 dBHz
C/(No+Io)	78.7 dBHz

### Satellite

Flux Density	-117.8 dBW/m2
SFD @ Terminal	-102.8 dBW/m2
Small Signal Gain (IBO/OBO)	2.0 dB
ОВО	12.5 dB

## Downlink

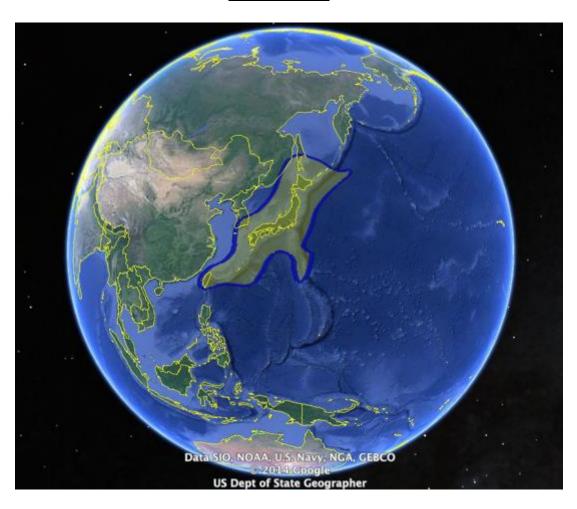
Frequency	12.000000 GHz
Transponder Sat. EIRP @ Beam Pe	60.0 dBW
Transponder Sat. EIRP @ Hub	60.0 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	12.6 dBW/4kHz
Carrier EIRP @ Beam Peak	44.8 dBW
Carrier EIRP @ Hub	44.8 dBW
Slant Range	38102 km
Space Loss, Ls	205.6 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.9 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	104.3 dBHz
C/(No+lo)	85.0 dBHz

## End to End

End to End C/(No+Io)	77.8 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	9.6 dB
Link Margin	2.1 dB

Forward Link Budget		Return Link Budget		
eXConnect Terminal		eXConnect Terminal		
Antenna Type	HR129	Antenna Type	HR129	
Lat	31.0 deg	Lat	31.0 deg	
Lon	-104.2 deg	Lon	-104.2 deg	
EIRP max	41.8 dBW	EIRP max	41.8 dBW	
G/T	11.4 dB/K	G/T	11.4 dB/K	
Satellite		Satellite		
Name	IS29e	Name	IS29e	
Longitude	-50.0 deg	Longitude	-50.0 deg	
Hub Earth Station	30.0 deg	Hub Earth Station	30.0 466	
Site	Mountainside	Site	Mountainside	
		Lat		
Lat	39.6 deg		39.6 deg	
Lon	-77.76 deg	Lon	-77.76 deg	
EIRP max	80.0 dBW	EIRP max	80.0 dBW	
G/T	37.5 dB/K	G/T	37.5 dB/K	
Signal		Signal		
Waveform	DVB-S2	Waveform	iDirect	
Modulation	QPSK	Modulation	QPSK	
Bits per symbol	2	Bits per symbol	2	
Spread Factor	1	Spread Factor	1	
Coding Rate	0.60	Coding Rate	0.80	
Overhead Rate	0.94	Overhead Rate	0.87	
Channel Spacing	1.20	Channel Spacing	1.20	
Spectral Efficiency (Rate/Noise BW)	1.13 bps/Hz	Spectral Efficiency (Rate/Noise BW)	1.39 bps/Hz	
Data Rate	5.08E+07 bps	Data Rate	9.25E+06 bps	
Information Rate (Data + Overhead)	· ·		· ·	
, , ,	5.40E+07 bps	Information Rate (Data + Overhead)	1.07E+07 bps	
Symbol Rate	4.50E+07 Hz	Symbol Rate	6.67E+06 Hz	
Chip Rate (Noise Bandwidth)	4.50E+07 Hz	Chip Rate (Noise Bandwidth)	6.67E+06 Hz	
Occupied Bandwidth	5.40E+07 Hz	Occupied Bandwidth	8.00E+06 Hz	
Power Equivelent Bandwidth	2.65E+07 Hz	Power Equivelent Bandwidth	2.24E+06 Hz	
C/N Threshold	2.7 dB	C/N Threshold	6.6 dB	
Uplink		Uplink		
Frequency	6.131 GHz	Frequency	14.344 GHz	
Back off	5.7 dB	Back off	1.2 dB	
EIRP Spectral Density	33.8 dBW/4kHz	EIRP Spectral Density	8.4 dBW/4kHz	
Slant Range	38106 km	Slant Range	39358 km	
Space Loss, Ls	199.8 dB	Space Loss, Ls	207.5 dB	
Pointing Loss, Lpnt	0.0 dB	Pointing Loss, Lpnt	0.1 dB	
Atmosphere / Weather Loss, La	0.5 dB	Atmosphere / Weather Loss, La	0.0 dB	
Radome, Lr	0.0 dB	Radome, Lr	0.5 dB	
- 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1				
Transponder G/T @ Hub	4.0 dB/K	Transponder G/T @ Terminal	17.3 dB/K	
Thermal Noise, C/No	106.6 dBHz	Thermal Noise, C/No	78.5 dBHz	
C/(No+lo)	106.1 dBHz	C/(No+lo)	78.0 dBHz	
Satellite		Satellite		
Flux Density	-88.8 dBW/m2	Flux Density	-122.8 dBW/m2	
SFD @ Hub	-77.0 dBW/m2	SFD @ Terminal	-94.3 dBW/m2	
Small Signal Gain (IBO/OBO)	2.0 dB	Small Signal Gain (IBO/OBO)	2.0 dB	
ОВО	9.8 dB	ОВО	26.5 dB	
Downlink		Downlink		
Frequency	12.106 GHz	Frequency	10.856 GHz	
Transponder Sat. EIRP @ Beam Peak	64.3 dBW	Transponder Sat. EIRP @ Beam Peak	52.7 dBW	
Transponder Sat. EIRP @ Terminal	63.3 dBW	Transponder Sat. EIRP @ Hub	52.7 dBW	
DL PSD Limit	14.0 dBW/4kHz	DL PSD Limit	14.0 dBW/4kHz	
DL PSD @ Beam Peak	14.0 dBW/4kHz	DL PSD @ Beam Peak	-6.1 dBW/4kHz	
Carrier EIRP @ Beam Peak	54.5 dBW	Carrier EIRP @ Beam Peak	26.2 dBW	
_				
Carrier EIRP @ Terminal	53.5 dBW	Carrier EIRP @ Hub	26.2 dBW	
Slant Range	39358 km	Slant Range	38106 km	
Space Loss, Ls	206.0 dB	Space Loss, Ls	204.8 dB	
Pointing Loss, Lpnt	0.0 dB	Pointing Loss, Lpnt	0.0 dB	
Atmosphere / Weather Loss, La	0.0 dB	Atmosphere / Weather Loss, La	3.1 dB	
Radome, Lr	0.5 dB	Radome, Lr	0.0 dB	
PCMA Loss	0.0 dB	PCMA Loss	0.0 dB	
Thermal Noise, C/No	87.0 dBHz	Thermal Noise, C/No	84.4 dBHz	
C/(No+lo)	80.5 dBHz	C/(No+lo)	79.5194 dBHz	
End to End		End to End		
End to End C/(No+lo)	80.5 dBHz	End to End C/(No+Io)	75.7 dBHz	
Implementation Loss	1.0 dB	Implementation Loss	0.0 dB	
End to End C/N w/ Imp Loss	3.0 dB	End to End C/N w/ Imp Loss	7.4 dB	
Link Margin	0.3 dB	Link Margin	0.8 dB	
ELLIK IVIGIBILI	0.5 UD	LIIIK IVIGI BIII	U.O UD	

# 13. JCSAT-5A





SKY Perfect JSAT Corporation 1-14-14, Akasaka, Minato-ku Tokyo 107-0052, Japan TEL +81-3-5571-7800

Ref# MD-A-16-013

July 12, 2016

Federal Communications Commission International Bureau 445 12th Street, S.W. Washington, D.C. 20554

Re: Engineering Certification of SKY Perfect JSAT Corporation for Astronics AeroSat

#### To Whom It May Concern:

This letter certifies that SKY Perfect JSAT Corporation ("JSAT") is aware that Astronics AeroSat Corporation ("Astronics AeroSat") is planning to seek a modification to its blanket authorization from the Federal Communications Commission ("FCC") to operate Ku-band transmit/receive earth stations aboard aircraft ("ESAAs") terminals, the HR129 and HR6400 terminals ("HR Terminals") with the JCSAT-5A satellite at 132° E.L and the Superbird C2 satellite at 144° E.L. JSAT understands that Astronics AeroSat will file the modification application pursuant to the FCC's rules governing ESAA terminal operations, including Section 25.227.

Based on the information provided by AeroSat, JSAT certifies that the proposed operation of the HR Terminals at the power density levels specified are consistent with existing coordination agreements with all adjacent satellite operators within +/- 6 degrees of orbital separation from JCSAT-5A and Superbird C2. JSAT also acknowledges that the proposed operation of the Astronics AeroSat HR Terminals has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable. If the FCC authorizes the operations proposed by Astronics AeroSat, JSAT will take into consideration the power density levels associated such operations in all future satellite network coordinations with other adjacent satellite operators.

Date July 2016

Sincerely,

SKY Perfect JSAT Corporation

Mitsuru Ishii

General Manager

Mobile Business Division

Global Business Group

Space & Satellite Business Unit

## **Link Budgets**

#### Forward Link Budget

HR6400

35.7 deg

Flitestream Terminal
Antenna Type

Lat

Lat	33.7	ueg		Lat
Lon	138.4	deg		Lon
G/T	12.4	dB/K	1	EIRP max
Satellite				Satellite
Name	JCSAT-5A		1 [	Name
Longitude	132.0	deg		Longitude
Hub Earth Station		_		Hub Earth Stat
Site	Tokyo			Site
Lat	35.74	deg		Lat
Lon		deg	1	Lon
EIRP max		dBW	1	G/T
Signal	00.0	u.s		Signal
Waveform	DVB-S2			Waveform
Modulation	16APSK		1	Modulation
Bits per symbol	10AF3R			Bits per symb
Spread Factor	1			Spread Factor
	0.83			
Coding Rate				Coding Rate
Overhead Rate	0.93		1	Overhead Rat
Channel Spacing	1.20		1	Channel Spac
Spectral Efficiency (Rate/Noise BW)		bps/Hz		Spectral Effici
Data Rate	6.97E+07		1	Data Rate
Information Rate (Data + Overhead)	7.50E+07			Information F
Symbol Rate	2.25E+07		1	Symbol Rate
Chip Rate (Noise Bandwidth)	2.25E+07			Chip Rate (No
Occupied Bandwidth	2.70E+07	Hz		Occupied Ban
C/N Threshold	12.4	dB	] [	C/N Threshole
Uplink			_ 1	Uplink
Frequency	14.259	GHz	1	Frequency
Back off	10.0	dB		Back off
EIRP Spectral Density	32.5	dBW/4kHz		EIRP Spectral
Slant Range	37218	km .		Slant Range
Space Loss, Ls	206.9			Space Loss, Ls
Pointing Loss, Lpnt	0.0		1	Pointing Loss,
Atmosphere / Weather Loss, La	3.0			Atmosphere /
Radome, Lr	0.0		1	Radome, Lr
Transponder G/T @ Hub		dB/K		Transponder
Thermal Noise, C/No		dBHz		Thermal Nois
C/(No+lo)		dBHz	1	C/(No+lo)
	36.2	ивпи		
Satellite	05.4	-IDM// 2		Satellite
Flux Density		dBW/m2	1	Flux Density
SFD @ Hub		dBW/m2		SFD @ Termir
Small Signal Gain (IBO/OBO)	2.4			Small Signal G
OBO	1.0	dB		ОВО
Downlink				Downlink
Frequency	12.511			Frequency
Transponder Sat. EIRP @ Beam Peak		dBW		Transponder
Transponder Sat. EIRP @ Terminal	56.0	dBW	ľ	Transponder
DL PSD Limit	19.5	dBW/4kHz		DL PSD Limit
DL PSD @ Beam Peak	19.0	dBW/4kHz		DL PSD @ Bea
Carrier EIRP @ Beam Peak	56.5	dBW	l l	Carrier EIRP @
Carrier EIRP @ Terminal	55.0	dBW	l l	Carrier EIRP @
Slant Range	37206	km		Slant Range
Space Loss, Ls	205.8	dB	1	Space Loss, Ls
Pointing Loss, Lpnt	0.1	dB		Pointing Loss,
Atmosphere / Weather Loss, La	0.0	dB		Atmosphere /
Radome, Lr	0.0			Radome, Lr
PCMA Loss	0.0			PCMA Loss
Thermal Noise, C/No		dBHz	1	Thermal Nois
C/(No+lo)	69.9	dBHz		C/(No+lo)
End to End	00.3	dDU-		End to End
End to End C/(No+Io)		dBHz		End to End C/
Implementation Loss	1.0			Implementati
End to End C/N w/ Imp Loss	14.8			End to End C/
Link Margin	2.4	an	j L	Link Margin

#### Return Link Budget

Flitestream Terminal		
Antenna Type	HR6400	
Lat	35.7	deg
Lon	138.4	deg
EIRP max	45.0	dBW
Satellite		
Name	JCSAT-5A	
Longitude	132.0	deg
Hub Earth Station		
Site	Tokyo	
Lat	35.74	deg
Lon	139	deg
G/T	35.5	dB/K
Signal		
Waveform	iDirect	
Modulation	QPSK	
Bits per symbol	2	
Spread Factor	1	
Coding Rate	0.75	
Overhead Rate	0.82	
Channel Spacing	1.20	
Spectral Efficiency (Rate/Noise BW)		bps/Hz
Data Rate	8.20E+06	
Information Rate (Data + Overhead)	1.00E+07	
Symbol Rate	6.67E+06	
Chip Rate (Noise Bandwidth)	6.67E+06	
Occupied Bandwidth	8.00E+06	
C/N Threshold	5.9	dB
Uplink		
Frequency	14.259	
Back off	0.0	-
EIRP Spectral Density		dBW/4kHz
Slant Range	37206   206.9	
Space Loss, Ls	0.1	
Pointing Loss, Lpnt Atmosphere / Weather Loss, La	0.0	
Radome, Lr	0.0	
Transponder G/T @ Terminal	10.0	
Thermal Noise, C/No	78.6	
C/(No+lo)	78.0	
Satellite	70.0	UDITE
Flux Density	-115.6	dBW/m2
SFD @ Terminal		dBW/m2
Small Signal Gain (IBO/OBO)	3.0	
OBO	21.2	
Downlink		
Frequency	12.511	GHz
Transponder Sat. EIRP @ Beam Peak	57.5	dBW
Transponder Sat. EIRP @ Hub	56.0	dBW
DL PSD Limit	19.5	dBW/4kHz
DL PSD @ Beam Peak	4.2	dBW/4kHz
Carrier EIRP @ Beam Peak	36.4	dBW
Carrier EIRP @ Hub	34.9	dBW
Slant Range	37218	km
Space Loss, Ls	205.8	dB
Pointing Loss, Lpnt	0.0	dB
Atmosphere / Weather Loss, La	3.9	dB
Radome, Lr	0.0	
PCMA Loss	0.0	dB
Thermal Noise, C/No	89.3	
C/(No+lo)	76.8	dBHz
End to End		
End to End C/(No+Io)	74.4	
Implementation Loss	0.0	
End to End C/N w/ Imp Loss	6.1	
Link Margin	0.2	an

0.2 dB

#### Forward Link Budget

### Return Link Budget

oVConnect Terminal		oVConnect Terminal	
Antenna Type	HR129	eXConnect Terminal Antenna Type	HR129
Lat	37.0 deg	Lat	37.0 deg
Lon	139.0 deg	Lon	139.0 deg
EIRP max	41.6 dBW	EIRP max	41.6 dBW
G/T	11.5 dB/K	G/T	11.5 dB/K
Satellite	11:3 UB/K	Satellite	11.5 db/k
	ICCAT FA		JCSAT-5A
Name	JCSAT-5A	Name	
Longitude	132.0 deg	Longitude	132.0 deg
Hub Earth Station		Hub Earth Station	
Site	Yokohama	Site	Yokohama
Lat	35.5 deg	Lat	35.5 deg
Lon	139.51 deg	Lon	139.51 deg
EIRP max	75.0 dBW	EIRP max	75.0 dBW
G/T	32.5 dB/K	G/T	32.5 dB/K
Signal		Signal	
Waveform	DVB-S2	Waveform	iDirect
Modulation	QPSK	Modulation	QPSK
Bits per symbol	2	Bits per symbol	2
Spread Factor	1	Spread Factor	1
Coding Rate	0.60	Coding Rate	0.50
Overhead Rate	0.94	Overhead Rate	0.83
Channel Spacing	1.20	Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	1.13 bps/Hz	Spectral Efficiency (Rate/Noise BW)	0.83 bps/Hz
Data Rate	1.50E+07 bps	Data Rate	5.55E+06 bps
Information Rate (Data + Overhead)	1.60E+07 bps	Information Rate (Data + Overhead)	6.67E+06 bps
Symbol Rate	1.33E+07 Hz	Symbol Rate	6.67E+06 Hz
Chip Rate (Noise Bandwidth)	1.33E+07 Hz	Chip Rate (Noise Bandwidth)	6.67E+06 Hz
Occupied Bandwidth	1.60E+07 Hz	Occupied Bandwidth	8.00E+06 Hz
Power Equivelent Bandwidth	2.20E+07 Hz	Power Equivelent Bandwidth	1.09E+06 Hz
C/N Threshold	2.7 dB	C/N Threshold	3.6 dB
Uplink	2.7 db	Uplink	3.0 db
Frequency	14.089 GHz	Frequency	14.089 GHz
Back off	17.7 dB	Back off	0.0 dB
EIRP Spectral Density	22.1 dBW/4kHz		9.4 dBW/4kHz
1 '	·	EIRP Spectral Density	
Slant Range	37212 km	Slant Range	37314 km 206.9 dB
Space Loss, Ls	206.8 dB	Space Loss, Ls	
Pointing Loss, Lpnt	0.0 dB	Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	3.3 dB	Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB	Radome, Lr	0.5 dB
Transponder G/T @ Hub	11.0 dB/K	Transponder G/T @ Terminal	11.0 dB/K
Thermal Noise, C/No	86.8 dBHz	Thermal Noise, C/No	73.7 dBHz
C/(No+lo)	86.3 dBHz	C/(No+lo)	73.2 dBHz
Satellite		Satellite	
Flux Density	-108.4 dBW/m2	Flux Density	-121.4 dBW/m2
SFD @ Hub	-97.0 dBW/m2	SFD @ Terminal	-97.0 dBW/m2
Small Signal Gain (IBO/OBO)	4.0 dB	Small Signal Gain (IBO/OBO)	4.0 dB
OBO	7.4 dB	OBO	20.5 dB
Downlink		Downlink	
Frequency	12.341 GHz	Frequency	12.341 GHz
Transponder Sat. EIRP @ Beam Peak	57.5 dBW	Transponder Sat. EIRP @ Beam Peak	57.5 dBW
Transponder Sat. EIRP @ Terminal	56.0 dBW	Transponder Sat. EIRP @ Hub	56.0 dBW
DL PSD Limit	19.5 dBW/4kHz	DL PSD Limit	19.5 dBW/4kHz
DL PSD @ Beam Peak	14.9 dBW/4kHz	DL PSD @ Beam Peak	4.8 dBW/4kHz
Carrier EIRP @ Beam Peak	50.1 dBW	Carrier EIRP @ Beam Peak	37.0 dBW
Carrier EIRP @ Terminal	48.6 dBW	Carrier EIRP @ Hub	35.5 dBW
Slant Range	37314 km	Slant Range	37212 km
Space Loss, Ls	205.7 dB	Space Loss, Ls	205.7 dB
Pointing Loss, Lpnt	0.0 dB	Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB	Atmosphere / Weather Loss, La	3.4 dB
Radome, Lr	0.5 dB	Radome, Lr	0.0 dB
PCMA Loss	0.0 dB	PCMA Loss	0.0 dB
	82.5 dBHz		
Thermal Noise, C/No		Thermal Noise, C/No	87.6 dBHz
C/(No+lo)	76.0 dBHz	C/(No+lo)	79.5350 dBHz
End to End C/(No.11a)	75 C JD11-	End to End	72.2 4011-
End to End C/(No+lo)	75.6 dBHz	End to End C/(No+Io)	72.3 dBHz
Implementation Loss	1.0 dB	Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	3.4 dB	End to End C/N w/ Imp Loss	4.1 dB
Link Margin	0.7 dB	Link Margin	0.5 dB

# 14. NSS-6





Federal Communications Commission International Bureau 445 12th Street, S.W. Washington, D.C. 20554 United States

15th September 2016

Subject: Engineering Certification for NSS-6

To Whom It May Concern:

This letter confirms that SES is aware that Astronics AeroSat Corporation ("Astronic AeroSat"), licensed by the Federal Communications Commission ("FCC"), has filed an application seeking a modification to its blanket authorization (the "Modification Application") to operate Ku-band Earth Stations Aboard Aircraft ("ESAA") transmit/receive terminals (Call Sign E140087) pursuant to ITU RR 5.504A and Section 25.227 of the Commission's rules, on domestic and international flights. Among other changes, the Modification Application is seeking authority for Astronics AeroSat's ESAA terminals to communicate with the NSS-6 satellite at 95°E.L. under the current ESAA rules, including Section 25.227.

Based upon the contents of the Modification Application and the representations made to SES by Astronics AeroSat concerning how it will operate on NSS-6 according to its letter dated 28 June 2016.

SES acknowledges that the proposed operation of the Astronics AeroSat ESAA terminals has the potential to create harmful interference to satellite networks adjacent to NSS-6 that may be unacceptable.

SES certifies that it has completed coordination as required under the FCC's rules and that the power density levels specified by Astronics AeroSat are consistent with any existing coordination agreements to which SES is a party to adjacent satellite operators within +/- 6 degrees of orbital separation from NSS-6.

If the FCC authorizes the operations proposed by Astronics AeroSat, SES will include the power density levels specified by Astronics AeroSat in all future satellite network coordination with other operators of satellites adjacent to NSS-6.

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www.ses.com

Company Registration Number (UEN) 200914437G



SES has also reviewed the discussion in the Modification Application regarding the off-axis EIRP density of Astronics AeroSat antennas communicating with NSS-6 in directions other than along the GSO plane. SES is of the view that the non-compliant emissions would not create interference to Ku-band geostationary satellites.

Yours sincerely,

Kevin Seow

VP Spectrum Management & Development - APAC

SES

## **Link Budgets**

#### Forward Link Budget

Flitestream Terminal		
Antenna Type	HR6400	
Lat	36.1	deg
Lon	136.4	deg
G/T	12.5	dB/K
Satellite		
Name	NSS-6	
Longitude	95.0	deg
Hub Earth Station Site	Cuprus	
Lat	Cyprus 34.859	don
Lon	33.384	
EIRP max		dBW
Signal	77.0	abvv
Waveform	DVB-S2	
Modulation	QPSK	
Bits per symbol	2	
Spread Factor	1	
Coding Rate	0.83330	
Overhead Rate	0.93477	
Channel Spacing	1.20000	
Spectral Efficiency (Rate/Noise BW)	1.55789	bps/Hz
Data Rate	4.67E+07	
Information Rate (Data + Overhead)	5.00E+07	bps
Symbol Rate	3.00E+07	Hz
Chip Rate (Noise Bandwidth)	3.00E+07	Hz
Occupied Bandwidth	3.60E+07	
C/N Threshold	5.6	dB
Uplink		
Frequency	13.900	
Back off	0.0	
EIRP Spectral Density		dBW/4kHz
Slant Range	40108	
Space Loss, Ls	207.4	
Pointing Loss, Lpnt	0.0	
Atmosphere / Weather Loss, La	5.5	
Radome, Lr	0.0	
Transponder G/T @ Hub		dB/K dBHz
Thermal Noise, C/No		dBHz
C/(No+lo) Satellite	97.8	ивпи
Flux Density	-91 O	dBW/m2
SFD @ Hub		dBW/m2
Small Signal Gain (IBO/OBO)	3.0	
OBO	2.4	
Downlink		
Frequency	12.647	GHz
Transponder Sat. EIRP @ Beam Peak		dBW
Transponder Sat. EIRP @ Terminal		dBW
DL PSD Limit	14.7	dBW/4kHz
DL PSD @ Beam Peak		dBW/4kHz
Carrier EIRP @ Beam Peak	52.1	dBW
Carrier EIRP @ Terminal		dBW
Slant Range	38631	km
Space Loss, Ls	206.2	dB
Pointing Loss, Lpnt	0.1	
Atmosphere / Weather Loss, La	0.0	dB
Radome, Lr	0.0	
PCMA Loss	0.0	
Thermal Noise, C/No		dBHz
C/(No+Io)	83.3	dBHz
End to End		
End to End C/(No+Io)		dBHz
Implementation Loss	1.0	
End to End C/N w/ Imp Loss	7.4	
Link Margin	1.8	4D

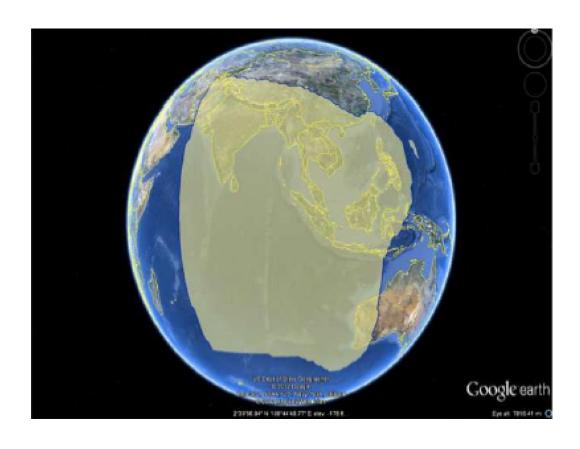
#### Return Link Budget

Return Link Budge	et	
Flitestream Terminal		
Antenna Type	HR6400	
Lat	36.1	deg
Lon	136.4	
EIRP max	45.2	dBW
Satellite		
Name	NSS-6	
Longitude	95.0	aeg
Hub Earth Station Site	Cyprus	
Lat	34.859	deg
Lon	33.384	
G/T		dB/K
Signal		
Waveform	iDirect	
Modulation	QPSK	
Bits per symbol	2	
Spread Factor	1	
Coding Rate	0.67	
Overhead Rate	0.85	
Channel Spacing	1.20	hns/!!-
Spectral Efficiency (Rate/Noise BW) Data Rate	7.54.E+06	bps/Hz
Information Rate (Data + Overhead)	7.54.E+06 8.89.E+06	
Symbol Rate	6.67.E+06	
Chip Rate (Noise Bandwidth)	6.67.E+06	
Occupied Bandwidth	8.00.E+06	
C/N Threshold	5.0	
Uplink		
Frequency	14.472	GHz
Back off	0.0	
EIRP Spectral Density		dBW/4kHz
Slant Range	38631	
Space Loss, Ls	207.4	
Pointing Loss, Lpnt	0.1	
Atmosphere / Weather Loss, La	0.0	
Radome, Lr Transponder G/T @ Terminal		dB/K
Thermal Noise, C/No		dBHz
C/(No+lo)		dBHz
Satellite	, 5.5	UDITE
Flux Density	-116.7	dBW/m2
SFD @ Terminal	-95.9	dBW/m2
Small Signal Gain (IBO/OBO)	3.0	
ОВО	17.8	dB
Downlink		
Frequency	11.676	
Transponder Sat. EIRP @ Beam Peak		dBW
Transponder Sat. EIRP @ Hub		dBW
DL PSD Limit DL PSD @ Beam Peak		dBW/4kHz dBW/4kHz
Carrier EIRP @ Beam Peak		dBW/4KHZ
Carrier EIRP @ Hub		dBW
Slant Range	40108	
Space Loss, Ls	205.9	
Pointing Loss, Lpnt	0.0	
Atmosphere / Weather Loss, La	6.5	
Radome, Lr	0.0	dB
PCMA Loss	0.0	
Thermal Noise, C/No	83.5	dBHz
C/(No+lo)	82.8	dBHz
End to End		
End to End C/(No+Io)		dBHz
Implementation Loss	0.0	
End to End C/N w/ Imp Loss	5.1	
Link Margin	0.1	uB

## Forward Link Budge

Mathematics	Forward Link Bu	dget	Return Link Bud	get
Internal Type	aVCannast Tarminal		aVCannast Tarminal	
Lat		HR129		HR129
In			1	
SIRP max		-		· ·
Satellite   Name				
Name   NSS-6   Longitude	G/T	12.3 dB/K	G/T	12.3 dB/K
Longitude	Satellite		Satellite	
Hub Earth Station	Name	NSS-6	Name	NSS-6
Site		95.0 deg		95.0 deg
Lat				
Inn				**
EIRP max		•		
Signal   Waveform   DVIB-52   Waveform   DVIB-52   Waveform   Modulation   BPSK   Bits per symbol   3   Bits per symbol   1   Spread Factor   1   Coding Rate   0.67   Coding Rate   0.67   Coding Rate   0.67   Coding Rate   0.94   Coverhead Rate   0.94   Coverhead Rate   0.94   Coverhead Rate   0.92   Channel Spacing   1.20   Channel Spacing   0.72   Channel Spacing   0.74   Chip Rate (Woise Bandwidth   3.00E+07 hz   Chip Rate (Woise Bandwidth   3.00E+05 hz   Chip Rate (Woise Bandwidth   3.00E+07 hz   Chip Rate (Woise Bandwidth   3.00E+05 hz   Chip Rate (Woise Bandwidth		-		
Signal   Waveform   DVB-S2   Waveform   DVB-S2   Waveform   DVB-S2   Waveform   DVB-S2   Waveform   DVB-S2   Waveform   DVB-S2   DVB-S2				
Waveform   DVB-S2   Modulation   BPSK   Bits per symbol   3   Spread Factor   1   Coding Rate   0.67   Overhead Bate   0.94   Channel Spacing   1.20   Spread Factor   2   Coding Rate   0.057   Overhead Bate   0.94   Channel Spacing   1.20   Spread Factor   2   Coding Rate   0.057   Overhead Bate   0.94   Channel Spacing   1.20   Spread Factor   2   Coding Rate   0.057   Overhead Bate   0.97   Channel Spacing   1.20   Spread Factor   2   Channel Spacing   1.20   Overhead Rate   0.054   Overhead Rate   0.		30.0 45/11		30.0 db/ K
Bits per symbol   3     1		DVB-S2		iDirect
Spread Factor   1	Modulation	8PSK	Modulation	BPSK
Coding Rate	Bits per symbol	3	Bits per symbol	1
Overhead Rate         0.94           Channel Spacing         1.20           Spectral Efficiency (Rate/Noise BW)         1.88 bps/Hz           Data Rate         5.64E+07 bps           Information Rate (Data + Overhead)         5.06E+07 bps           Symbol Rate         3.00E+07 Hz           Chip Rate (Noise Bandwidth)         3.06E+07 Hz           Occupied Bandwidth         3.06E+07 Hz           Power Equivelent Bandwidth         3.56E+07 Hz           C/N Threshold         7.4 dB           Uplink         1.20 dB           Frequency         13.891 GHz           Back off         0.7 dB           EIRP Spectral Density         40.5 dBW/4kHz           Share Loss, Ls         2074 dB           Pointing Loss, Lpn         0.0 dB           Radome, Lr         0.0 dB           Transponder C/T @ Hub         5.0 dB/K           Thermal Noise, C/No         9.9 z dBHz           STOE @ Hub         8.5 d BW           Transponder C/T @ Hub         8.5 d BW/m²           STOE @ Hub         8.5 d BW/m²           STOE @ Hub         8.5 d BW/m²           STOE @ Hub         8.5 d BW/m²           Transponder Sat. EIRP @ Beam Peak         5.4 d BW           T	Spread Factor	1	Spread Factor	2
Channel Spacing   1.20   Spectral Efficiency (Rate/Noise BW)   1.28 bps/Hz   Data Rate   5.64E+07 bps   Data Rate   5.64E+07 bps   Data Rate   3.00E+07 Hz   Symbol Rate   3.00E+07 Hz   Symbol Rate   3.00E+07 Hz   Symbol Rate   3.34E+06 Hz   Symbol Rate	Coding Rate	0.67	Coding Rate	0.67
Spectral Efficiency (Rate/Noise BW)   1.88 bps/Hz   Data Rate   1.61E+06 bps   Information Rate (Data + Overhead)   6.00E+07 bps   Information Rate (Data + Overhead)   2.22E+06 bps   Symbol Rate   3.34E+06 bps   Symbol Rate   Symbol Rat				
Data Rate   1.61£-06 bps   Information Rate (Data + Overhead)   6.00€+07 bps   Symbol Rate   3.00€+07 hz   Symbol Rate   3.30€+07 hz   Symbol Rate   3.34€+06 hz   Symbol Rate   Symbo				
Information Rate (Data + Overhead)   6.00E+07   bps   Symbol Rate (Data + Overhead)   3.00E+07   bps   Symbol Rate (Data + Overhead)   3.22E+06   bps   Symbol Rate   3.34E+06   bts   Chip Rate (Noise Bandwidth)   3.00E+07   btz   Chip Rate (Noise Bandwidth)   6.67E+06   btz   Occupied Bandwidth   3.5E+07   btz   Chip Rate (Noise Bandwidth)   6.67E+06   btz   Occupied Bandwidth   3.5E+07   btz   Chip Rate (Noise Bandwidth)   3.5E+07   btz   Chip Rate (Noise Bandwidth)   3.5E+05   btz   Occupied Bandwidth   Occupied Bandwidth   3.5E+05   btz   Occupied Bandwid				
Symbol Rate   3.00E+07 Hz   Chip Rate (Noise Bandwidth)   8.00E+06 Hz   Chip Rate (Noise Bandwidth)   8.00E+		· ·		· ·
Chip Rate (Noise Bandwidth   3.00E+07 Hz   Occupied Bandwidth   3.60E+07 Hz   Occupied Bandwidth   3.60E+07 Hz   Occupied Bandwidth   3.0E+07 Hz   Occupied Bandwidth   3.0E+07 Hz   Occupied Bandwidth   3.0E+06 Hz   Power Equivelent Bandwi	•	•	•	
Decupied Bandwidth   3,50E+07 Hz   Power Equivelent Bandwidth   3,50E+07 Hz   7,4 dB   7,4	1 '		·	
Power Equivelent Bandwidth			<b>■</b> 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
C/N Threshold         7.4 dB           Uplink         C/N Threshold         -1.2 dB           Frequency         13.891 GHz         6.7 dB           Back off         0.7 dB         1.390 GHz           EIRP Spectral Density         40.5 dBW/4kHz         EIRP Spectral Density         9.6 dBW/4kHz           Slant Range         40090 km         Space Loss, Ls         207.4 dB           Space Loss, Ls         207.4 dB         Space Loss, Ls         207.4 dB           Pointing Loss, Lpnt         0.0 dB         Atmosphere / Weather Loss, La         5.8 dB         Admosphere / Weather Loss, La         0.0 dB           Radome, Lr         0.0 dB/K         Transponder G/T @ Hub         0.0 dB/K         Transponder G/T @ Terminal         8.0 dB/K           Thermal Noise, C/No         99.7 dBHz         C/(No+lo)         70.5 dBHz           Flux Density         -89.6 dBW/m2         Small Signal Gain (IBO/OBO)         3.0 dB           Small Signal Gain (IBO/OBO)         3.0 dB         Small Signal Gain (IBO/OBO)         3.0 dB           OBO         1.0 dB         Transponder Sat. EIRP @ Beam Peak         54.5 dBW           Transponder Sat. EIRP @ Beam Peak         54.5 dBW         Transponder Sat. EIRP @ Hub         50.0 dBW           Transponder Sat. EIRP @ Beam Peak			· · · · · · · · · · · · · · · · · · ·	
Uplink   Frequency	1		· · · · · · · · · · · · · · · · · · ·	
Back off         0.7 d B           EIRP Spectral Density         40.5 dBW/4kHz           EIRP Spectral Density         40.05 dBW/4kHz           Slant Range         38728 km           Space Loss, Ls         207.4 dB           Space Loss, Ls         207.4 dB           Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         5.8 dB           Radome, Lr         0.0 dB           Transponder G/T @ Hub         5.0 dB/K           Transponder G/T @ Hub         5.0 dB/K           Thermal Noise, C/No         99.7 dBHz           C/(No+lo)         99.2 dBHz           Satellite         Thermal Noise, C/No         70.5 dB           Transponder Sate Signal Gain (iBO/OBO)         3.0 dB         Thermal Noise, C/No         70.5 dBHz           SFD @ Hub         -85.6 dBW/m2         Satellite         Flux Density         -121.5 dBW/m2           SFD @ Hub         -85.6 dBW/m2         Small Signal Gain (iBO/OBO)         3.0 dB           OBO         1.0 dB         Downlink         Downlink         Transponder Sat. EIRP @ Beam Peak         54.5 dBW           Transponder Sat. EIRP @ Terminal         54.0 dBW         Transponder Sat. EIRP @ Hub         50.0 dBW           D FSO Limit         14.7 dBW/4kHz	Uplink	<u>'</u>		
EIRP Spectral Density	Frequency	13.891 GHz	Frequency	14.390 GHz
Slant Range	Back off		Back off	
Space Loss, Ls	EIRP Spectral Density	40.5 dBW/4kHz	EIRP Spectral Density	
Pointing Loss, Lpnt	_		<u> </u>	
Atmosphere / Weather Loss, La         5.8 dB         Atmosphere / Weather Loss, La         0.0 dB           Radome, Lr         0.0 dB         Radome, Lr         0.5 dB           Transponder G/T @ Hub         5.0 dB/K         Transponder G/T @ Terminal         8.0 dB/K           Thermal Noise, C/No         99.7 dBHz         Thermal Noise, C/No         70.5 dBHz           C/(No+lo)         99.2 dBHz         5.8 dBW/m2         5.9 dBW/m2 </td <td></td> <td></td> <td>I *</td> <td></td>			I *	
Radome, Lr	_ · · · · · · · · · · · · · · · · · · ·			
Transponder G/T @ Hub         5.0 dB/K           Thermal Noise, C/No         99.7 dBHz           C/(No+lo)         99.2 dBHz           Satellite           Flux Density         -89.6 dBW/m2           SFD @ Hub         -85.6 dBW/m2           SFD @ Hub         -85.6 dBW/m2           Small Signal Gain (IBO/OBO)         3.0 dB           OBO         1.0 dB           Downlink         Downlink           Frequency         12.647 GHz           Transponder Sat. EIRP @ Beam Peak         54.5 dBW           Transponder Sat. EIRP @ Terminal         54.0 dBW           DL PSD Limit         14.7 dBW/4kHz           DL PSD Limit         14.7 dBW/4kHz           Carrier EIRP @ Beam Peak         53.5 dBW           Carrier EIRP @ Beam Peak         53.0 dBW           Slant Range         38728 km           Slant Range         40090 km           Space Loss, Ls         206.3 dB           Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         0.0 dB           Radome, Lr         0.5 dB           Pointing Loss, Lpnt         0.0 dB           PCMA Loss         0.0 dB           PCMA Loss         0.0 dB <t< td=""><td></td><td></td><td></td><td></td></t<>				
Thermal Noise, C/No				
C/(No+lo)         99.2 dBHz           Satellite         Satellite           Flux Density         -89.6 dBW/m2           SFD @ Hub         -85.6 dBW/m2           Small Signal Gain (IBO/OBO)         3.0 dB           OBO         1.0 dB           Downlink           Frequency         12.647 GHz           Transponder Sat. EIRP @ Beam Peak         54.5 dBW           Transponder Sat. EIRP @ Beam Peak         54.0 dBW           DL PSD Limit         14.7 dBW/4kHz           DL PSD Limit         14.7 dBW/4kHz           DL PSD Limit         14.7 dBW/4kHz           Carrier EIRP @ Beam Peak         53.5 dBW           Carrier EIRP @ Beam Peak         53.5 dBW           Carrier EIRP @ Terminal         53.0 dBW           Slant Range         38728 km           Space Loss, Ls         206.3 dB           Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         0.0 dB           PCMA Loss         0.0 dB		· ·		· ·
Satellite           Flux Density         -89.6 dBW/m2         SFD @ Hub         -85.6 dBW/m2         SFD @ Terminal         -95.6 dBW/m2         -95.6 dBW/m2         SFD @ Terminal         -95.6 dBW/m2         SFD @ Terminal         -95.6 dBW/m2         3.0 dB         0BO         3.0 dB         0BO         1.0 dB         0BO         1.0 dB         0BO         22.9 dB         0BO         3.0 dB         0BO         22.9 dB         0BO         22.9 dB         0BO         3.0 dB         0BO         22.9 dB         0BO         0BO         22.9 dB         0BO         0BO         3.0 dB         0BO         3.0 dB         0BO         0BO         3.0 dB         0BO         0BO         3.0 dB         0BO         0BO         3.0 dB         0BO				
SFD @ Hub         -85.6 dBW/m2           Small Signal Gain (IBO/OBO)         3.0 dB           OBO         1.0 dB           Downlink         Downlink           Frequency         12.647 GHz           Transponder Sat. EIRP @ Beam Peak         54.5 dBW           Transponder Sat. EIRP @ Terminal         54.0 dBW           DL PSD Limit         14.7 dBW/4kHz           DL PSD Limit         14.7 dBW/4kHz           DL PSD Beam Peak         14.7 dBW/4kHz           Carrier EIRP @ Beam Peak         53.5 dBW           Carrier EIRP @ Terminal         53.0 dBW           Slant Range         38728 km           Space Loss, Ls         206.3 dB           Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         0.0 dB           PCMA Loss         0.0 dB           Thermal Noise, C/No         87.1 dBHz           Freduency         11.594 GHz           Transponder Sat. EIRP @ Beam Peak         50.0 dBW           Transponder Sat. EIRP @ Hub         50.0 dBW           Carrier EIRP @ Beam Peak         27.1 dBW           Carrier EIRP @ Beam Peak         27.1 dBW           Slant Range         40090 km           Space Loss, Ls         205.8 dB		'		
Small Signal Gain (IBO/OBO)         3.0 dB         Small Signal Gain (IBO/OBO)         3.0 dB           OBO         1.0 dB         OBO         22.9 dB           Downlink         Frequency           Frequency         12.647 GHz         Frequency         11.594 GHz           Transponder Sat. EIRP @ Beam Peak         54.5 dBW         Transponder Sat. EIRP @ Beam Peak         50.0 dBW           DL PSD Limit         14.7 dBW/4kHz         DL PSD Limit         14.7 dBW/4kHz           CL PSD Beam Peak         14.7 dBW/4kHz         DL PSD @ Beam Peak         5.1 dBW/4kHz           Carrier EIRP @ Beam Peak         53.0 dBW         Carrier EIRP @ Beam Peak         27.1 dBW           Carrier EIRP @ Terminal         53.0 dBW         Carrier EIRP @ Beam Peak         27.1 dBW           Slant Range         38728 km         Slant Range         40090 km           Space Loss, Ls         206.3 dB         Space Loss, Ls         205.8 dB           Pointing Loss, Lpnt         0.0 dB         Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         0.0 dB         Atmosphere / Weather Loss, La         6.4 dB           Radome, Lr         0.5 dB         PCMA Loss         0.0 dB           PCMA Loss         0.0 dB         PCMA Loss         0.0	Flux Density	-89.6 dBW/m2	Flux Density	-121.5 dBW/m2
DBO	SFD @ Hub	-85.6 dBW/m2	SFD @ Terminal	-95.6 dBW/m2
Downlink         Downlink           Frequency         12.647 GHz           Transponder Sat. EIRP @ Beam Peak         54.5 dBW           Transponder Sat. EIRP @ Terminal         54.0 dBW           DL PSD Limit         14.7 dBW/4kHz           DL PSD @ Beam Peak         14.7 dBW/4kHz           DL PSD @ Beam Peak         14.7 dBW/4kHz           Carrier EIRP @ Beam Peak         53.5 dBW           Carrier EIRP @ Beam Peak         53.0 dBW           Slant Range         38728 km           Slant Range         38728 km           Space Loss, Ls         206.3 dB           Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         0.0 dB           Radome, Lr         0.0 dB           PCMA Loss         0.0 dB           Thermal Noise, C/No         87.1 dBHz           C/(No+lo)         84.0 dBHz           End to End         1.0 dB           End to End         1.0 dB           End to End C/(No+lo)         88.9 dBHz           Implementation Loss         0.0 dB           End to End C/N w/ Imp Loss         8.1 dB	Small Signal Gain (IBO/OBO)	3.0 dB	Small Signal Gain (IBO/OBO)	
Frequency		1.0 dB		22.9 dB
Transponder Sat. EIRP @ Beam Peak         54.5 dBW         Transponder Sat. EIRP @ Beam Peak         50.0 dBW           Transponder Sat. EIRP @ Terminal         54.0 dBW         Transponder Sat. EIRP @ Hub         50.0 dBW           DL PSD Limit         14.7 dBW/4kHz         DL PSD Limit         14.7 dBW/4kHz           DL PSD Beam Peak         14.7 dBW/4kHz         DL PSD @ Beam Peak         5.1 dBW/4kHz           Carrier EIRP @ Beam Peak         53.5 dBW         Carrier EIRP @ Beam Peak         27.1 dBW           Carrier EIRP @ Terminal         53.0 dBW         Carrier EIRP @ Hub         27.1 dBW           Slant Range         38728 km         Slant Range         40090 km           Space Loss, Ls         206.3 dB         Space Loss, Ls         205.8 dB           Pointing Loss, Lpnt         0.0 dB         Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         0.0 dB         Atmosphere / Weather Loss, La         6.4 dB           Radome, Lr         0.0 dB         Radome, Lr         0.0 dB           PCMA Loss         0.0 dB         PCMA Loss         0.0 dB           Thermal Noise, C/No         79.5 dBHz         Thermal Noise, C/No         79.5 dBHz           End to End         End to End         End to End         End to End C/(No+Io)         68.5 dBHz </td <td></td> <td></td> <td></td> <td></td>				
Transponder Sat. EIRP @ Terminal         54.0 dBW         Transponder Sat. EIRP @ Hub         50.0 dBW           DL PSD Limit         14.7 dBW/4kHz         DL PSD Limit         14.7 dBW/4kHz           DL PSD @ Beam Peak         14.7 dBW/4kHz         DL PSD @ Beam Peak         -5.1 dBW/4kHz           Carrier EIRP @ Beam Peak         53.5 dBW         Carrier EIRP @ Beam Peak         27.1 dBW           Carrier EIRP @ Terminal         53.0 dBW         Carrier EIRP @ Beam Peak         27.1 dBW           Slant Range         38728 km         Slant Range         40090 km           Space Loss, Ls         206.3 dB         Space Loss, Ls         205.8 dB           Pointing Loss, Lpnt         0.0 dB         Atmosphere / Weather Loss, La         6.4 dB           Radome, Lr         0.5 dB         Radome, Lr         0.0 dB           PCMA Loss         0.0 dB         PCMA Loss         0.0 dB           Thermal Noise, C/No         87.1 dBHz         Thermal Noise, C/No         79.5 dBHz           C/(No+lo)         84.0 dBHz         C/(No+lo)         74.0090 dBHz           End to End C/(No+lo)         88.9 dBHz         Implementation Loss         0.0 dB           End to End C/N w/ Imp Loss         8.1 dB         End to End C/N w/ Imp Loss         0.3 dB				
DL PSD Limit			_ ·	
DL PSD @ Beam Peak	_			
Carrier EIRP @ Beam Peak         53.5 dBW         Carrier EIRP @ Beam Peak         27.1 dBW           Carrier EIRP @ Terminal         53.0 dBW         Carrier EIRP @ Hub         27.1 dBW           Slant Range         38728 km         Slant Range         40090 km           Space Loss, Ls         206.3 dB         Space Loss, Ls         205.8 dB           Pointing Loss, Lpnt         0.0 dB         Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         0.0 dB         Atmosphere / Weather Loss, La         6.4 dB           Radome, Lr         0.0 dB         Radome, Lr         0.0 dB           PCMA Loss         0.0 dB         PCMA Loss         0.0 dB           Thermal Noise, C/No         87.1 dBHz         Thermal Noise, C/No         79.5 dBHz           C/(No+lo)         84.0 dBHz         C/(No+lo)         74.0090 dBHz           End to End         End to End         End to End           End to End C/(No+lo)         68.5 dBHz         Implementation Loss         0.0 dB           End to End C/N w/ Imp Loss         8.1 dB         End to End C/N w/ Imp Loss         0.3 dB				
Carrier EIRP @ Terminal         53.0 dBW         Carrier EIRP @ Hub         27.1 dBW           Slant Range         38728 km         Slant Range         40090 km           Space Loss, Ls         206.3 dB         Space Loss, Ls         205.8 dB           Pointing Loss, Lpnt         0.0 dB         Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         0.0 dB         Atmosphere / Weather Loss, La         6.4 dB           Radome, Lr         0.0 dB         Radome, Lr         0.0 dB           PCMA Loss         0.0 dB         PCMA Loss         0.0 dB           Thermal Noise, C/No         79.5 dBHz         C/(No+lo)         74.0090 dBHz           End to End         End to End         End to End         End to End         68.5 dBHz           Implementation Loss         1.0 dB         Implementation Loss         0.0 dB         End to End C/N w/ Imp Loss         0.3 dB				
Slant Range         38728 km         Slant Range         40090 km           Space Loss, Ls         206.3 dB         Space Loss, Ls         205.8 dB           Pointing Loss, Lpnt         0.0 dB         Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         0.0 dB         Atmosphere / Weather Loss, La         6.4 dB           Radome, Lr         0.5 dB         Radome, Lr         0.0 dB           PCMA Loss         0.0 dB         PCMA Loss         0.0 dB           Thermal Noise, C/No         87.1 dBHz         Thermal Noise, C/No         79.5 dBHz           C/(No+lo)         84.0 dBHz         C/(No+lo)         74.0090 dBHz           End to End         End to End         End to End           End to End C/(No+lo)         83.9 dBHz         Implementation Loss         0.0 dB           End to End C/N w/ Imp Loss         8.1 dB         Implementation Loss         0.0 dB				
Space Loss, Ls         206.3 dB         Space Loss, Ls         205.8 dB           Pointing Loss, Lpnt         0.0 dB         Atmosphere / Weather Loss, La         0.0 dB           Atmosphere / Weather Loss, La         0.0 dB         Atmosphere / Weather Loss, La         6.4 dB           Radome, Lr         0.0 dB         0.0 dB         PCMA Loss         0.0 dB           PCMA Loss         0.0 dB         PCMA Loss         0.0 dB           Thermal Noise, C/No         87.1 dBHz         Thermal Noise, C/No         79.5 dBHz           C/(No+lo)         84.0 dBHz         C/(No+lo)         74.0090 dBHz           End to End C/(No+lo)         83.9 dBHz         End to End C/(No+lo)         68.5 dBHz           Implementation Loss         1.0 dB         Implementation Loss         0.0 dB           End to End C/N w/ Imp Loss         8.1 dB         End to End C/N w/ Imp Loss         0.3 dB	_		_	
Pointing Loss, Lpnt   0.0 dB   Atmosphere / Weather Loss, La   0.0 dB   Atmosphere / Weather Loss, La   0.0 dB   Atmosphere / Weather Loss, La   6.4 dB   Radome, Lr   0.0 dB   0.0	_			
Atmosphere / Weather Loss, La     0.0 dB       Radome, Lr     0.5 dB       PCMA Loss     0.0 dB       PcMA Loss     0.0 dB       Thermal Noise, C/No     87.1 dBHz       C/(No+lo)     84.0 dBHz       End to End     End to End C/(No+lo)       End to End C/(No+lo)     83.9 dBHz       Implementation Loss     1.0 dB       End to End C/N w/ Imp Loss     8.1 dB       End to End C/N w/ Imp Loss     0.3 dB       End to End C/N w/ Imp Loss     0.3 dB	1 .		· · · · · · · · · · · · · · · · · · ·	
PCMA Loss         0.0 dB         PCMA Loss         0.0 dB           Thermal Noise, C/No         87.1 dBHz         Thermal Noise, C/No         79.5 dBHz           C/(No+lo)         84.0 dBHz         C/(No+lo)         74.0090 dBHz           End to End C/(No+lo)         83.9 dBHz         End to End C/(No+lo)         68.5 dBHz           Implementation Loss         1.0 dB         Implementation Loss         0.0 dB           End to End C/N w/ Imp Loss         8.1 dB         End to End C/N w/ Imp Loss         0.3 dB				
Thermal Noise, C/No	Radome, Lr	0.5 dB	Radome, Lr	0.0 dB
C/(No+lo)         84.0 dBHz         C/(No+lo)         74.0090 dBHz           End to End         End to End C/(No+lo)         End to End         End to End C/(No+lo)         68.5 dBHz           Implementation Loss         1.0 dB         Implementation Loss         0.0 dB           End to End C/N w/ Imp Loss         8.1 dB         End to End C/N w/ Imp Loss         0.3 dB		0.0 dB		0.0 dB
End to End         End to End           End to End C/(No+lo)         83.9 dBHz           Implementation Loss         1.0 dB           End to End C/N w/ Imp Loss         8.1 dB           End to End C/N w/ Imp Loss         0.3 dB           End to End C/N w/ Imp Loss         0.3 dB				
End to End C/(No+Io)         83.9 dBHz         End to End C/(No+Io)         68.5 dBHz           Implementation Loss         1.0 dB         Implementation Loss         0.0 dB           End to End C/N w/ Imp Loss         8.1 dB         End to End C/N w/ Imp Loss         0.3 dB		84.0 dBHz		74.0090 dBHz
Implementation Loss         1.0 dB         Implementation Loss         0.0 dB           End to End C/N w/ Imp Loss         8.1 dB         End to End C/N w/ Imp Loss         0.3 dB		02.0 (2.)		co = !=··
End to End C/N w/ Imp Loss 8.1 dB End to End C/N w/ Imp Loss 0.3 dB				
	1 *		<b>■</b> *	
UI COMPANIAL LINGSWALL	1			
	Errix Margin	0.7 UD	LIIIK WAREIII	1.J UD

# 15. SUPERBIRD C2





SKY Perfect JSAT Corporation 1-14-14, Akasaka, Minato-ku Tokyo 107-0052, Japan TEL +81-3-5571-7800

Ref# MD-A-16-013

July 12, 2016

Federal Communications Commission International Bureau 445 12th Street, S.W. Washington, D.C. 20554

Re: Engineering Certification of SKY Perfect JSAT Corporation for Astronics AeroSat

To Whom It May Concern:

This letter certifies that SKY Perfect JSAT Corporation ("JSAT") is aware that Astronics AeroSat Corporation ("Astronics AeroSat") is planning to seek a modification to its blanket authorization from the Federal Communications Commission ("FCC") to operate Ku-band transmit/receive earth stations aboard aircraft ("ESAAs") terminals, the HR129 and HR6400 terminals ("HR Terminals") with the JCSAT-5A satellite at 132° E.L and the Superbird C2 satellite at 144° E.L. JSAT understands that Astronics AeroSat will file the modification application pursuant to the FCC's rules governing ESAA terminal operations, including Section 25.227.

Based on the information provided by AeroSat, JSAT certifies that the proposed operation of the HR Terminals at the power density levels specified are consistent with existing coordination agreements with all adjacent satellite operators within +/- 6 degrees of orbital separation from JCSAT-5A and Superbird C2. JSAT also acknowledges that the proposed operation of the Astronics AeroSat HR Terminals has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable. If the FCC authorizes the operations proposed by Astronics AeroSat, JSAT will take into consideration the power density levels associated such operations in all future satellite network coordinations with other adjacent satellite operators.

Date July 2016

Sincerely,

SKY Perfect JSAT Corporation

Mitsuru Ishii

General Manager

Mobile Business Division

Global Business Group

Space & Satellite Business Unit

## **Link Budgets**

## Superbird-C2 LinkBudget

### Forward Link Budget

Forw	ard Link Budget		Return Link Budget
Flitestream Terminal		Flitestream Terminal	
Site	Mindoro Strait	Site	Mir
Antenna Type	HR6400	Antenna Type	
Lat	11.6 deg	Lat	
Lon	119.4 deg	Lon	
G/T	12.6 dB/K	Input Power Max	
Satellite		EIRP max	
Name	Superbird C2	Satellite	
Transponder	K27	Name	Si
Longitude	144.0 deg	Transponder	
Hub Earth Station		Longitude	
Site	Hong Kong	Hub Earth Station	
Lat	22.396 deg	Site	
Lon	114.11 deg	Lat	

Lon	114.11 deg
EIRP max	80.1 dBW
Signal	
Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.50
Overhead Rate	0.83
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.83 bps/Hz
Data Rate	1.86E+07 bps
Information Rate (Data + Overhead)	2.25E+07 bps
Symbol Rate	2.25E+07 Hz
Chip Rate (Noise Bandwidth)	2.25E+07 Hz
Occupied Bandwidth	2.70E+07 Hz
C/N Threshold	0.9 dB

Uplink	
Frequency	14.433000 GHz
Power Control Mode	Automatic Uplink Power Control
Back off	0.0 dB
EIRP Spectral Density	42.6 dBW/4kHz
Slant Range	37247 km
Space Loss, Ls	207.1 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	2.9 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	-5.0 dB/K
Thermal Noise, C/No	93.8 dBHz
C/(No+Io)	93.2 dBHz
Catallita	

Satellite	
Flux Density	-85.3 dBW/m2
SFD @ Hub	-79.4 dBW/m2
Small Signal Gain (IBO/OBO)	1.4 dB
ОВО	4.5 dB

DOWNIINK	
Frequency	12.703000 GHz
Transponder Sat. EIRP @ Beam Peak	45.0 dBW
Transponder Sat. EIRP @ Terminal	45.0 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	3.1 dBW/4kHz
Carrier EIRP @ Beam Peak	40.6 dBW
Carrier EIRP @ Terminal	40.6 dBW
Slant Range	36596 km
Space Loss, Ls	205.8 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	75.8 dBHz
C/(No+Io)	75.8 dBHz

End to End	
End to End C/(No+Io)	75.8 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	1.2 dB
Link Margin	0.3 dB

riitestream rerminai	
Site	Mindoro Strait
Antenna Type	HR6400
Lat	11.6 deg
Lon	119.4 deg
Input Power Max	16.0 dBW
EIRP max	45.0 dBW
C + 1111	•

Name	Superbird C2
Transponder	K20
Longitude	144.0 deg
Hub Earth Station	

TIUD Laitii Station	
Site	Hong Kong
Lat	22.396 deg
Lon	114.11 deg
G/T	37.1 dB/K

Signal	
Waveform	iDirectRL-SF8
Modulation	BPSK
Bits per symbol	1
Spread Factor	4
Coding Rate	0.4310000
Overhead Rate	0.6764600
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.07 bps/Hz
Data Rate	4.81E+05 bps
Information Rate (Data + Overhead)	7.11E+05 bps
Symbol Rate	1.65E+06 Hz
Chip Rate (Noise Bandwidth)	6.60E+06 Hz
Occupied Bandwidth	7.92E+06 Hz
C/N Threshold	-5.0 dB

C/ 14 TITI CONTOIN	5.0 45
Uplink	
Frequency	14.184000 GHz
Power Control Mode	Automatic Uplink Power Control
Back off	1.0 dB
EIRP Spectral Density	11.8 dBW/4kHz
Slant Range	36596 km
Space Loss, Ls	206.8 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
Transponder G/T @ Terminal	1.0 dB/K
Thermal Noise, C/No	66.7 dBHz
C/(No+lo)	66.2 dBHz

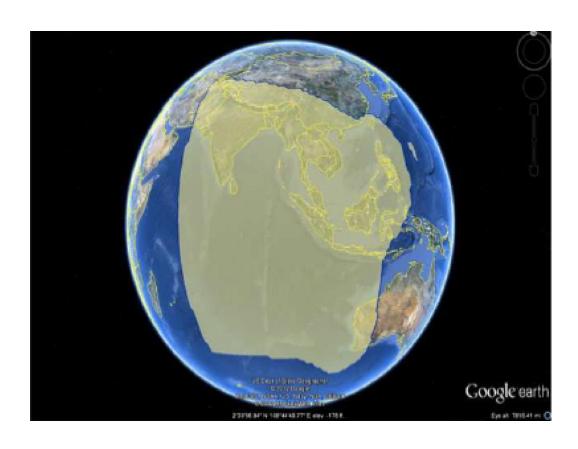
Satellite	
Flux Density	-118.3 dBW/m2
SFD @ Terminal	-85.4 dBW/m2
Small Signal Gain (IBO/OBO)	1.4 dB
ОВО	31.5 dB

4kHz
4kHz

End to End	
End to End C/(No+Io)	63.7 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	-4.5 dB
Link Margin	0.5 dB

Lon	Forward Link B	udget	Return Link Bu	dget
Lat	eXConnect Terminal		eXConnect Terminal	
Lon 103 9 deg EIRP max 4 2.0 dBW 6/T 1.3 dB/K 5Atellite 1.3 dB/K 5At	Antenna Type	HR129	Antenna Type	HR129
EIRP max	Lat	1.0 deg	Lat	1.0 deg
Stretilite	Lon	103.9 deg	Lon	103.9 deg
Satellite   She C2   Longitude   144.0 deg   Hub Earth Station   Site   Longitude   144.0 deg   Longitude   Longitude   144.0 deg   Longitude   Longitu	EIRP max	42.0 dBW	EIRP max	42.0 dBW
Name	G/T	11.3 dB/K	G/T	11.3 dB/K
Longitude				
Hub Earth Station				
Site		144.0 deg		144.0 deg
Lat		H		U K
Lon         114.18 deg         Lon         114.18 deg           LIRP max         80.0 dBW         EIRP max         80.0 dBW           Signal         Signal         Signal           Waveform         DVB-52         Modulation         BPSK           Modulation         OPSK         Modulation         BPSK           Bits per ymbol         2         Bits per symbol         1           Spread Factor         4         6         5           Coding Rate         0.50         Coding Rate         0.50           Overhead Rate         0.83         Coding Rate         0.50           Comannel Spacing         1.20         Spectral Efficiency (Rate/Noise BW)         0.83 bps/Hz         Spectral Efficiency (Rate/Noise BW)         0.99 bp           Spread Factor         4         0.74         Channel Spacing         1.20         Channel Spacing         1.20           Spectral Efficiency (Rate/Noise BW)         0.83 bps/Hz         Spectral Efficiency (Rate/Noise BW)         0.99 bp           Data Rate         1.66 total         4.00 total Rate         1.67 total Rate         0.74 total Rate           Chip Rate (Noise Bandwidth)         2.25 to 70 tbz         Chyp Rate (Mose Bandwidth)         2.6 total Rate         1.6 total Rate				
EIRP max		-		_
Signal		_		_
Signal   Waveform   DVB-52   Waveform   DVB-52   Waveform   DVB-52   Waveform   DVB-52   Waveform   DVB-52   Waveform   DVB-52   Bits per symbol   2   Bits per symbol   1   Spread Factor   4   Coding Rate   0.50   Cod				
Waveform   DV8-52   Maveform   DV8-52   Bits per symbol   2   Spread Factor   1   Spread Factor   4   Spread Factor   5   Sp		37.3 UB/K		37.3 UD/K
Modulation   QPSK   Bits per symbol   2   Bits per symbol   1   Spread Factor   1   Spread Factor   1   Spread Factor   4   Coding Rate   0.50   Coding Rate   0.50   Coding Rate   0.50   Coding Rate   0.50   Coding Rate   0.74   Channel Spacing   1.20   Dysectral Efficiency (Rate/Noise BW)   0.09 bp Data Rate   1.866+07 bps   Information Rate (Data + Overhead)   8.256+07 bps   Symbol Rate   2.256+07 htz   Symbol Rate   1.676+06 ht   Chip Rate (Noise Bandwidth)   2.756+07 htz   Chip Rate (Noise Bandwidth)   2.756+07 htz   Chip Rate (Noise Bandwidth)   6.676+06 ht   Chip Rate	Ĕ	DVB-S2		iDirect
Bits per symbol   2   Spread Factor				
Spread Factor				
Coding Rate         0.50           Overhead Rate         0.83         Overhead Rate         0.74           Channel Spacing         1.20         Overhead Rate         0.74           Channel Spacing         1.20         Channel Spacing         1.20           Spectral Efficiency (Rate/Noise BW)         0.83 bps/Hz         Spactral Efficiency (Rate/Noise BW)         0.09 bp           Data Rate         1.86E+07 bps         Information Rate (Data + Overhead)         8.34E+05 bp           Symbol Rate         2.25E+07 Hz         Chip Rate (Noise Bandwidth)         6.67E+06 Hz           Ocucyled Bandwidth         2.70E+07 Hz         Ocupled Bandwidth         6.67E+06 Hz           Orwer Equivelent Bandwidth         2.70E+07 Hz         Ocupled Bandwidth         8.0E+06 Hz           C/N Threshold         0.9 dB         Dyllink         1.4433 GHz         Power Equivelent Bandwidth         8.0E+05 Hz           C/N Threshold         0.9 dB         Dyllink         1.120 GH         Power Equivelent Bandwidth         8.0E+05 Hz           C/N Threshold         0.9 dB         3.4 dB         ElRP Spectral Density         9.7 dB         2.0E+05 Hz           Slant Range         37251 km         Space Loss, Ls         Sack off         Sack off         Sack off         Sack off         Sack o				
Overhead Rate         0.83           Channel Spacing         1.20           Channel Spacing         1.20           Spectral Efficiency (Rate/Noise BW)         0.83 bps/Hz           Data Rate         1.86E407 bps           Information Rate (Data + Overhead)         2.25E407 bps           Information Rate (Data + Overhead)         2.25E407 Hz           Chip Rate (Noise Bandwidth)         2.70E407 Hz           Chip Rate (Noise Bandwidth)         2.70E407 Hz           Chyall Rate (Noise Bandwidth)         2.70E407 Hz           Cocupied Bandwidth         2.70E407 Hz           Power Equivelent Bandwidth         2.70E407 Hz           CN Threshold         0.9 dB           Uplink         14.433 GHz           Frequency         14.433 GHz           Back off         3.4 dB           EIRP Spectral Density         39.1 dBW/4kHz           Space Loss, Ls         207.1 dB           Space Loss, Ls         207.1 dB           Space Loss, Ls         208.0 dB           Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         6.1 dB           Radome, Lr         0.0 dB           Transponder G/T @ Hub         4.0 dB/K           Thermal Noise, C/No <td< td=""><td></td><td></td><td></td><td></td></td<>				
Channel Spacing	-		_	
Spectral Efficiency (Rate/Noise BW)         0.83 bps/Hz 1.86E407 bps         Spectral Efficiency (Rate/Noise BW)         0.90 bp Data Rate           Information Rate (Data + Overhead)         2.25E407 bps Symbol Rate         5.3E+07 bps Information Rate (Data + Overhead)         8.34E+05 bp Information Rate (Data + Overhead)         8.3E+06+06 his College Information Rate (Data + Overhead)         8.3E+0				
Data Rate				0.09 bps/Hz
Information Rate (Data + Overhead)   2.25E+07 bps   Symbol Rate   2.25E+07 Hz   Symbol Rate   1.67E+06 Hz   1.67		· ·		6.13E+05 bps
Chip Rate (Noise Bandwidth)   2.25E+07 Hz   Chip Rate (Noise Bandwidth)   6.67E+06 Hz   Occupied Bandwidth   2.70E+07 Hz   Power Equivelent Bandwidth   3.0E+06 Hz   3.47E+05 Hz   C/N Threshold   0.9 dB   Uplink	Information Rate (Data + Overhead)	2.25E+07 bps	Information Rate (Data + Overhead)	8.34E+05 bps
Occupied Bandwidth         2.70E+07 Hz         Occupied Bandwidth         8.00E+06 Hz           Power Equivelent Bandwidth         2.70E+07 Hz         Power Equivelent Bandwidth         3.47E+05 Hz           C/N Threshold         0.9 dB         Uplink         Uplink         Uplink         Frequency         14.433 GHz         Frequency         14.120 Gi         Uplink         Section S	Symbol Rate	2.25E+07 Hz	Symbol Rate	1.67E+06 Hz
Power Equivelent Bandwidth	Chip Rate (Noise Bandwidth)	2.25E+07 Hz	Chip Rate (Noise Bandwidth)	6.67E+06 Hz
C/N Threshold	Occupied Bandwidth	2.70E+07 Hz	Occupied Bandwidth	8.00E+06 Hz
Uplink         Uplink           Frequency         14.433 GHz           Back off         3.4 dB           EIRP Spectral Density         39.1 dBW/4kHz           Slant Range         37251 km           Slant Range         37251 km           Space Loss, Ls         207.1 dB           Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         6.1 dB           Radome, Lr         0.0 dB           Transponder G/T @ Hub         -4.0 dB/K           Transponder G/T @ Hub         -4.0 dB/K           Transponder G/T @ Hub         -4.0 dB/K           Transponder G/T @ Terminal         1.0 dB           Thermal Noise, C/No         88.1 dBHz           C/(No+lo)         87.6 dBHz           Statellite         Thermal Noise, C/No         64.1 dB           Flux Density         -91.9 dBW/m2         STo @ Hub         -89.0 dBW/m2           STA Stallite         Stallite         Stallite           Flux Density         -91.9 dBW/m2         STo @ Hub         -89.0 dBW/m2           SD WILL         STO @ Hub         -89.0 dBW/m2         STO @ Terminal         -95.0 dB           Small Signal Gain (IBO/OBO)         2.4 dB         OBO         0BO         23.7 dB	Power Equivelent Bandwidth	2.70E+07 Hz	Power Equivelent Bandwidth	3.47E+05 Hz
Frequency	C/N Threshold	0.9 dB	C/N Threshold	-5.6 dB
Back off         3.4 dB         Back off         0.0 dE           EIRP Spectral Density         39.1 dBW/4kHz         EIRP Spectral Density         9.7 dB           Space Loss, Ls         207.1 dB         Slant Range         37518 km           Space Loss, Ls         207.1 dB         Space Loss, Ls         206.9 dB           Pointing Loss, Lpnt         0.0 dB         Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         6.1 dB         Atmosphere / Weather Loss, La         0.0 dB           Radome, Lr         0.0 dB         Atmosphere / Weather Loss, La         0.0 dB           Transponder G/T @ Hub         -4.0 dB/K         Transponder G/T @ Terminal         1.0 dB           Thermal Noise, C/No         88.1 dBHz         Thermal Noise, C/No         64.1 dB           C/(No+lo)         87.6 dBHz         Thermal Noise, C/No         64.1 dB           Satellite         Stellite         Thermal Noise, C/No         64.1 dB           Flux Density         -91.9 dBW/m2         SFD @ Terminal         9.0 dB           SFD @ Hub         -89.0 dBW/m2         SFD @ Terminal         9.0 dB           SFD @ Hub         -89.0 dBW/m2         SFD @ Terminal         9.0 dB           SFD @ Terminal         45.0 dBW         Transponder Sat.	<u> </u>		<u> </u>	
EIRP Spectral Density         39.1 dBW/4kHz         EIRP Spectral Density         9.7 dE           Slant Range         37251 km         Slant Range         37518 km           Space Loss, Ls         207.1 dB         Space Loss, Ls         206.9 dE           Pointing Loss, Lpnt         0.0 dB         Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         6.1 dB         Atmosphere / Weather Loss, La         0.0 dB           Radome, Lr         0.0 dB         Radome, Lr         0.5 dB           Transponder G/T @ Hub         -4.0 dB/K         Transponder G/T @ Terminal         1.0 dE           C/(No+lo)         87.6 dBHz         Thermal Noise, C/No         64.1 dE           Satellite         Satellite         Satellite           Flux Density         -91.9 dBW/m2         SFD @ Terminal         -95.0 dE           SPD @ Hub         -89.0 dBW/m2         SFD @ Terminal         -95.0 dE           Small Signal Gain (iBO/OBO)         2.4 dB         OBO         0.5 dB           Downlink         Frequency         12.703 GHz         Frequency         12.390 GI           Transponder Sat. EIRP @ Beam Peak         46.0 dBW         Transponder Sat. EIRP @ Beam Peak         46.0 dE           L PSD @ Beam Peak         8.0 dBW/4kHz <td< td=""><td></td><td></td><td></td><td>14.120 GHz</td></td<>				14.120 GHz
Slant Range         37251 km         Slant Range         37518 km           Space Loss, Ls         207.1 dB         Space Loss, Ls         206.9 dB           Pointing Loss, Lpnt         0.0 dB         Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         6.1 dB         Atmosphere / Weather Loss, La         0.0 dB           Radome, Lr         0.0 dB         Radome, Lr         0.5 dB           Transponder G/T @ Hub         -4.0 dB/K         Transponder G/T @ Terminal         1.0 dE           Thermal Noise, C/No         88.1 dBHz         Thermal Noise, C/No         64.1 dB           C/(No+lo)         87.6 dBHz         C/(No+lo)         63.6 dB           Satellite         Thermal Noise, C/No         64.1 dB         C/(No+lo)         63.6 dB           Satellite         Stellite         Flux Density         -91.9 dBW/m2         SFD @ Terminal Noise, C/No         64.1 dB         64.1 dB           SFD @ Hub         -89.0 dBW/m2         SFD @ Terminal Noise, C/No         64.1 dB         64.1 dB         66.5 dB         65.0 dB         66.0 dB         66.0 dB         66.0 dB         66.0 dB         66.0 dB         66.0 dB <td< td=""><td></td><td></td><td></td><td>0.0 dB</td></td<>				0.0 dB
Space Loss, Ls         207.1 dB         Space Loss, Ls         206.9 dE           Pointing Loss, Lpnt         0.0 dB         Pointing Loss, Lpnt         0.0 dE           Atmosphere / Weather Loss, La         6.1 dB         Atmosphere / Weather Loss, La         0.0 dE           Radome, Lr         0.0 dB         Radome, Lr         0.5 dE           Transponder G/T @ Hub         -4.0 dB/K         Transponder G/T @ Terminal         1.0 dE           Thermal Noise, C/No         88.1 dBHz         Thermal Noise, C/No         64.1 dE           C/(No+lo)         87.6 dBHz         Thermal Noise, C/No         64.1 dE           Satellite         Stellite         Thermal Noise, C/No         64.1 dE           SFD @ Hub         -91.9 dBW/m2         Stellite         Stellite           SFD @ Hub         -89.0 dBW/m2         SFD @ Terminal         -95.0 dE           Small Signal Gain (IBO/OBO)         2.4 dB         Small Signal Gain (IBO/OBO)         2.4 dB           OBO         0.5 dB         DBO         23.7 dE           Downlink         Downlink         Frequency         12.390 GI           Transponder Sat. EIRP @ Beam Peak         46.0 dEW         Transponder Sat. EIRP @ Beam Peak         46.0 dE           DL PSD @ Beam Peak         8.0 dBW/4kHz         DL P		· ·		9.7 dBW/4kHz
Pointing Loss, Lpnt	_		<u> </u>	
Atmosphere / Weather Loss, La				
Radome, Lr         0.0 dB         Radome, Lr         0.5 dB           Transponder G/T @ Hub         -4.0 dB/K         Transponder G/T @ Terminal         1.0 dB           Thermal Noise, C/No         88.1 dBHz         Thermal Noise, C/No         64.1 dB           C/(No+lo)         87.6 dBHz         5.0 dB           Satellite           Flux Density         -91.9 dBW/m2         5FD @ Terminal         -95.0 dB           SPD @ Hub         -89.0 dBW/m2         5FD @ Terminal         -95.0 dB           Small Signal Gain (IBO/OBO)         2.4 dB         0BO         0BO         23.7 dB           OBO         0.5 dB         0BO         0BO         23.7 dB           Downlink           Frequency         12.703 GHz         Frequency         12.390 GI           Transponder Sat. EIRP @ Beam Peak         46.0 dBW         Transponder Sat. EIRP @ Beam Peak         46.0 dBW           Transponder Sat. EIRP @ Terminal         13.0 dBW/4kHz         DL PSD Limit         13.0 dBW/4kHz           DL PSD @ Beam Peak         8.0 dBW/4kHz         DL PSD @ Beam Peak         -9.9 dB           Carrier EIRP @ Beam Peak         45.5 dBW         Carrier EIRP @ Beam Peak         2.3 dB           Carrier EIRP @ Terminal         44.5 dB			- · · · · · · · · · · · · · · · · · · ·	
Transponder G/T @ Hub         -4.0 dB/K         Transponder G/T @ Terminal         1.0 dB/K           Thermal Noise, C/No         88.1 dBHz         Thermal Noise, C/No         64.1 dB           C/(No+lo)         87.6 dBHz         Thermal Noise, C/No         64.1 dB           Satellite         Flux Density         -91.9 dBW/m2         Satellite           SFD @ Hub         -89.0 dBW/m2         SFD @ Hub         SFD @ Terminal         -95.0 dB           Small Signal Gain (IBO/OBO)         2.4 dB         Small Signal Gain (IBO/OBO)         2.4 dB           OBO         0.5 dB         Small Signal Gain (IBO/OBO)         2.4 dB           OBO         0.5 dB         Small Signal Gain (IBO/OBO)         2.4 dB           OBO         0.5 dB         OBO         23.7 dB           Downlink         Frequency         Terminal         Downlink           Frequency         12.390 GH         Transponder Sat. EIRP @ Beam Peak         46.0 dBW           Transponder Sat. EIRP @ Beam Peak         46.0 dBW         Transponder Sat. EIRP @ Hub         42.0 dB           DL PSD @ Beam Peak         8.0 dBW/4kHz         DL PSD @ Beam Peak         9.9 dB           Carrier EIRP @ Beam Peak         45.5 dBW				
Thermal Noise, C/No				
C/(No+lo)         87.6 dBHz           Satellite         Satellite           Flux Density         -91.9 dBW/m2           SFD @ Hub         -89.0 dBW/m2           Small Signal Gain (IBO/OBO)         2.4 dB           OBO         0.5 dB           Downlink         Downlink           Frequency         12.703 GHz           Transponder Sat. EIRP @ Beam Peak         46.0 dBW           Transponder Sat. EIRP @ Terminal         45.0 dBW           DL PSD Limit         13.0 dBW/4kHz           DL PSD @ Beam Peak         8.0 dBW/4kHz           Carrier EIRP @ Beam Peak         45.5 dBW           Carrier EIRP @ Beam Peak         45.5 dBW           Carrier EIRP @ Terminal         44.5 dBW           Slant Range         37518 km           Space Loss, Ls         206.0 dB           Space Loss, Ls         206.0 dB           Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         0.0 dB           Radome, Lr         0.0 dB           PCMA Loss         0.0 dB				·
Satellite           Flux Density         -91.9 dBW/m2           SFD @ Hub         -89.0 dBW/m2           Small Signal Gain (IBO/OBO)         2.4 dB           OBO         0.5 dB           Downlink           Downlink           Downlink           Transponder Sat. EIRP @ Beam Peak         46.0 dBW           Transponder Sat. EIRP @ Terminal         45.0 dBW           DL PSD Limit         13.0 dBW/4kHz           DL PSD @ Beam Peak         8.0 dBW/4kHz           Carrier EIRP @ Beam Peak         45.5 dBW           Carrier EIRP @ Beam Peak         45.5 dBW           Carrier EIRP @ Terminal         44.5 dBW           Slant Range         37518 km           Space Loss, Ls         206.0 dB           Space Loss, Ls         206.0 dB           Space Loss, Ls         205.7 dE           Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         0.0 dB           Radome, Lr         0.0 dB           PCMA Loss         0.0 dB           PCMA Loss         0.0 dB				
Flux Density		87.0 UBHZ		05.0 UDII2
SFD @ Hub         -89.0 dBW/m2         SFD @ Terminal         -95.0 dB           Small Signal Gain (IBO/OBO)         2.4 dB         Small Signal Gain (IBO/OBO)         2.4 dB           OBO         0.5 dB         OBO         23.7 dB           Downlink         Downlink         Downlink         Downlink           Frequency         12.703 GHz         Transponder Sat. EIRP @ Beam Peak         46.0 dBW           Transponder Sat. EIRP @ Terminal         45.0 dBW         Transponder Sat. EIRP @ Hub         42.0 dB           D L PSD Limit         13.0 dBW/4kHz         DL PSD Limit         13.0 db           D L PSD @ Beam Peak         8.0 dBW/4kHz         DL PSD Limit         13.0 db           Carrier EIRP @ Beam Peak         45.5 dBW         Carrier EIRP @ Beam Peak         -9.9 dB           Carrier EIRP @ Beam Peak         45.5 dBW         Carrier EIRP @ Beam Peak         22.3 dB           Carrier EIRP @ Terminal         44.5 dBW         Carrier EIRP @ Beam Peak         23.7 dB           Slant Range         375.18 km         SB         SB         SB         SB         205.7 dB         SB           Space Loss, Ls         206.0 dB         Pointing Loss, Lpnt         0.0 dB         Atmosphere / Weather Loss, La         6.8 dB         Atmosphere / Weather Loss, La         6.8 dB<		-91 9 dBW/m2		-121.1 dBW/m2
Small Signal Gain (IBO/OBO)         2.4 dB         Small Signal Gain (IBO/OBO)         2.4 dB           OBO         0.5 dB         OBO         23.7 dB           Downlink         Downlink         Downlink         Downlink           Frequency         12.703 GHz         Frequency         12.390 GI           Transponder Sat. EIRP @ Beam Peak         46.0 dBW         Transponder Sat. EIRP @ Beam Peak         46.0 dBW           DL PSD Limit         13.0 dBW/4kHz         DL PSD Limit         13.0 dB           DL PSD @ Beam Peak         8.0 dBW/4kHz         DL PSD @ Beam Peak         -9.9 dB           Carrier EIRP @ Beam Peak         45.5 dBW         Carrier EIRP @ Beam Peak         22.3 dB           Carrier EIRP @ Terminal         44.5 dBW         Carrier EIRP @ Beam Peak         22.3 dB           Slant Range         37518 km         Slant Range         37251 km           Space Loss, Ls         206.0 dB         Space Loss, Ls         205.7 dB           Pointing Loss, Lpnt         0.0 dB         Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         0.0 dB         Atmosphere / Weather Loss, La         6.8 dB           Radome, Lr         0.0 dB         PCMA Loss         0.0 dB	1		• • • • • • • • • • • • • • • • • • •	-95.0 dBW/m2
OBO         23.7 dB           Downlink           Downlink           Frequency         12.703 GHz           Transponder Sat. EIRP @ Beam Peak         46.0 dBW         Transponder Sat. EIRP @ Beam Peak         45.0 dBW           Transponder Sat. EIRP @ Terminal         45.0 dBW         Transponder Sat. EIRP @ Hub         42.0 dB           DL PSD Limit         13.0 dBW/4kHz         DL PSD Limit         13.0 dB           DL PSD @ Beam Peak         45.5 dBW         Carrier EIRP @ Beam Peak         -9.9 dB           Carrier EIRP @ Terminal         44.5 dBW         Carrier EIRP @ Beam Peak         22.3 dB           Carrier EIRP @ Terminal         44.5 dBW         Slant Range         37251 km           Space Loss, Ls         206.0 dB         Space Loss, Ls         205.7 dB           Pointing Loss, Lpnt         0.0 dB         Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         0.5 dB         Radome, Lr         Pome, Lamp of the proper o				
Downlink         Downlink           Frequency         12.703 GHz         Frequency         12.390 GHz           Transponder Sat. EIRP @ Beam Peak         46.0 dBW         Transponder Sat. EIRP @ Beam Peak         46.0 dB           Transponder Sat. EIRP @ Terminal         45.0 dBW         Transponder Sat. EIRP @ Hub         42.0 dB           DL PSD Limit         13.0 dBW/4kHz         DL PSD Limit         13.0 dB           DL PSD @ Beam Peak         8.0 dBW/4kHz         DL PSD @ Beam Peak         -9.9 dB           Carrier EIRP @ Beam Peak         45.5 dBW         Carrier EIRP @ Beam Peak         2.3 dB           Carrier EIRP @ Terminal         44.5 dBW         Carrier EIRP @ Hub         18.3 dB           Slant Range         37518 km         Slant Range         37251 km           Space Loss, Ls         206.0 dB         Space Loss, Ls         205.7 dB           Pointing Loss, Lpnt         0.0 dB         Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         0.0 dB         Radome, Lr         0.0 dB           PCMA Loss         0.0 dB         PCMA Loss         0.0 dB				23.7 dB
Frequency         12.703 GHz         Frequency         12.390 Giz           Transponder Sat. EIRP @ Beam Peak         46.0 dBW         Transponder Sat. EIRP @ Beam Peak         46.0 dB           DL PSD Limit         13.0 dBW/4kHz         DL PSD Limit         11.3.0 dBW/4kHz           DL PSD @ Beam Peak         8.0 dBW/4kHz         DL PSD Limit         11.3.0 dBW           Carrier EIRP @ Beam Peak         45.5 dBW         Carrier EIRP @ Beam Peak         -9.9 dE           Carrier EIRP @ Terminal         44.5 dBW         Carrier EIRP @ Beam Peak         22.3 dE           Slant Range         37518 km         Slant Range         37251 km           Space Loss, Ls         206.0 dB         Space Loss, Ls         205.7 dE           Pointing Loss, Lpnt         0.0 dB         Pointing Loss, Lpnt         0.0 dE           Atmosphere / Weather Loss, La         0.0 dB         Atmosphere / Weather Loss, La         6.8 dE           Radome, Lr         0.0 dB         PCMA Loss         0.0 dE				
Transponder Sat. EIRP @ Terminal         45.0 dBW         Transponder Sat. EIRP @ Hub         42.0 dB           DL PSD Limit         13.0 dBW/4kHz         DL PSD Limit         13.0 dB           DL PSD @ Beam Peak         8.0 dBW/4kHz         DL PSD @ Beam Peak         -9.9 dB           Carrier EIRP @ Beam Peak         45.5 dBW         Carrier EIRP @ Beam Peak         22.3 dB           Carrier EIRP @ Terminal         44.5 dBW         Carrier EIRP @ Hub         18.3 dB           Slant Range         37518 km         Slant Range         37251 kn           Space Loss, Ls         206.0 dB         Space Loss, Ls         205.7 dB           Pointing Loss, Lpnt         0.0 dB         Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         0.0 dB         Atmosphere / Weather Loss, La         6.8 dB           Radome, Lr         0.5 dB         Radome, Lr         0.0 dB           PCMA Loss         0.0 dB         PCMA Loss         0.0 dB	Frequency	12.703 GHz	Frequency	12.390 GHz
Transponder Sat. EIRP @ Terminal         45.0 dBW         Transponder Sat. EIRP @ Hub         42.0 dB           DL PSD Limit         13.0 dBW/4kHz         DL PSD Limit         13.0 dB           DL PSD @ Beam Peak         8.0 dBW/4kHz         DL PSD @ Beam Peak         -9.9 dB           Carrier EIRP @ Beam Peak         45.5 dBW         Carrier EIRP @ Beam Peak         22.3 dB           Carrier EIRP @ Terminal         44.5 dBW         Carrier EIRP @ Hub         18.3 dB           Slant Range         37518 km         Slant Range         37251 kn           Space Loss, Ls         206.0 dB         Space Loss, Ls         205.7 dB           Pointing Loss, Lpnt         0.0 dB         Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         0.0 dB         Atmosphere / Weather Loss, La         6.8 dB           Radome, Lr         0.5 dB         Radome, Lr         0.0 dB           PCMA Loss         0.0 dB         PCMA Loss         0.0 dB		46.0 dBW		46.0 dBW
DL PSD @ Beam Peak         8.0 dBW/4kHz         DL PSD @ Beam Peak         -9.9 dE           Carrier EIRP @ Beam Peak         45.5 dBW         Carrier EIRP @ Beam Peak         22.3 dE           Carrier EIRP @ Terminal         44.5 dBW         Carrier EIRP @ Hub         18.3 dE           Slant Range         37518 km         Slant Range         37251 km           Space Loss, Ls         206.0 dB         Space Loss, Ls         205.7 dE           Pointing Loss, Lpnt         0.0 dB         Atmosphere / Weather Loss, La         6.8 dE           Atmosphere / Weather Loss, La         0.5 dB         Radome, Lr         0.0 dE           PCMA Loss         0.0 dB         PCMA Loss         0.0 dE		45.0 dBW		42.0 dBW
Carrier EIRP @ Beam Peak         45.5 dBW         Carrier EIRP @ Beam Peak         22.3 dE           Carrier EIRP @ Terminal         44.5 dBW         Carrier EIRP @ Hub         18.3 dE           Slant Range         37518 km         Slant Range         37251 kr           Space Loss, Ls         206.0 dB         Space Loss, Ls         205.7 dE           Pointing Loss, Lpnt         0.0 dB         Pointing Loss, Lpnt         0.0 dE           Atmosphere / Weather Loss, La         6.8 dE         Radome, Lr         0.0 dB           PCMA Loss         0.0 dB         PCMA Loss         0.0 dE	DL PSD Limit		DL PSD Limit	13.0 dBW/4kHz
Carrier EIRP @ Terminal         44.5 dBW         Carrier EIRP @ Hub         18.3 dE           Slant Range         37518 km         Slant Range         37251 kn           Space Loss, Ls         206.0 dB         Space Loss, Ls         205.7 dE           Pointing Loss, Lpnt         0.0 dB         Pointing Loss, Lpnt         0.0 dE           Atmosphere / Weather Loss, La         0.0 dB         Atmosphere / Weather Loss, La         6.8 dE           Radome, Lr         0.5 dB         Radome, Lr         0.0 dE           PCMA Loss         0.0 dB         PCMA Loss         0.0 dE	DL PSD @ Beam Peak	8.0 dBW/4kHz	DL PSD @ Beam Peak	-9.9 dBW/4kHz
Slant Range         37518 km         Slant Range         37251 kn           Space Loss, Ls         206.0 dB         Space Loss, Ls         205.7 dE           Pointing Loss, Lpnt         0.0 dB         Pointing Loss, Lpnt         0.0 dE           Atmosphere / Weather Loss, La         0.0 dB         Atmosphere / Weather Loss, La         6.8 dE           Radome, Lr         0.5 dB         Radome, Lr         0.0 dE           PCMA Loss         0.0 dB         PCMA Loss         0.0 dE	Carrier EIRP @ Beam Peak	45.5 dBW	Carrier EIRP @ Beam Peak	22.3 dBW
Space Loss, Ls         206.0 dB         Space Loss, Ls         205.7 dE           Pointing Loss, Lpnt         0.0 dB         Pointing Loss, Lpnt         0.0 dE           Atmosphere / Weather Loss, La         0.0 dB         Atmosphere / Weather Loss, La         6.8 dE           Radome, Lr         0.5 dB         Radome, Lr         0.0 dE           PCMA Loss         0.0 dB         PCMA Loss         0.0 dE	Carrier EIRP @ Terminal	44.5 dBW	Carrier EIRP @ Hub	18.3 dBW
Pointing Loss, Lpnt 0.0 dB Pointing Loss, Lpnt 0.0 dB Atmosphere / Weather Loss, La 0.0 dB Atmosphere / Weather Loss, La 6.8 dB Radome, Lr 0.5 dB Radome, Lr 0.0 dB PCMA Loss 0.0 dB PCMA Loss 0.0 dB	Slant Range	37518 km	Slant Range	37251 km
Atmosphere / Weather Loss, La 0.0 dB Atmosphere / Weather Loss, La 6.8 dE Radome, Lr 0.5 dB Radome, Lr 0.0 dB PCMA Loss 0.0 dB PCMA Loss 0.0 dB	1		I *	205.7 dB
Radome, Lr         0.5 dB         Radome, Lr         0.0 dE           PCMA Loss         0.0 dB         PCMA Loss         0.0 dE				0.0 dB
PCMA Loss 0.0 dB PCMA Loss 0.0 dE				6.8 dB
				0.0 dB
				0.0 dB
	Thermal Noise, C/No	77.9 dBHz	Thermal Noise, C/No	71.7 dBHz
		77.2 dBHz		69.8315 dBHz
End to End  End to End C/(No.16)  76.9 dDHz  Find to End C/(No.16)  73.7 dE		76 0 Juli-		62.7 JDII-
				62.7 dBHz 0.0 dB
	·		I *	-5.6 dB
			· · · · · · · · · · · · · · · · · · ·	-5.6 dB 0.0 dB
Link Wangin U.O U.E	and the same	1.7 UD	Ellik Midigili	J.U UD

# 16. TELSTAR 11N





Telesat, 1601 Telesat Court Ottawa, ON, Canada K1B 5P4 27 May 2016

Federal Communications Commission International Bureau 445 12<sup>th</sup> Street SW Washington, DC 20554

Re: Engineering Certification for Astronics AeroSat

To Whom It May Concern:

This letter certifies that Telesat is aware that Astronics AeroSat Corporation ("Astronics AeroSat") is planning to seek authorization from the Federal Communications Commission ("FCC") to operate Ku-band transmit/receive earth stations aboard aircraft ("ESAA") terminals to communicate with the Anik G1, Telstar 12V, and Telstar 11N satellites which are located at 107.3°W, 15°W, and 37.5°W, respectively. Specifically, we understand that Astronics AeroSat seeks to operate two types of Ku-band antennas, HR6400 antenna and HR129 antenna, for communication with these satellites for commercial purposes consistent with the FCC's Part 25 rules, including Section 25.227.

Based on the information provided by Astronics AeroSat, Telesat understands the technical characteristics of the HR6400 and HR129 antennas and Telesat (i) recognizes that operation of these terminals at the power density levels provided to Telesat is consistent with the existing coordination agreements with all adjacent satellite operators within +/- 6 degrees of orbital separation from Anik G1, Telstar 12V, and Telstar 11N; (ii) acknowledges that the proposed operation of these terminals has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable; and (iii) if the FCC authorizes the operations proposed by Astronics AeroSat, Telesat will take into consideration the power density levels associated with such operations in all future satellite network coordinations with adjacent satellite operators.

Sincerely,

**BAHRAM BORNA** 

Satellite Spectrum Coordination Engineer

Telesat

## **Link Budgets**

Forward Link Budget		
eXConnect Terminal		
Antenna Type	HR129	
Lat	14.9	-
Lon	-85.1	deg dBW
EIRP max G/T		dB/K
Satellite	11.2	UD/ K
Name	Telstar 11N	
Longitude	-37.6	deg
Hub Earth Station		
Site	Cologne	
Lat	50.94	-
Lon EIRP max	6.96	dBW
G/T		dB/K
Signal	3	40,11
Waveform	DVB-S2	
Modulation	QPSK	
Bits per symbol	2	
Spread Factor	1	
Coding Rate	0.67	
Overhead Rate	0.94	
Channel Spacing Spectral Efficiency (Rate/Noise BW)	1.20	hns/U-
Spectral Efficiency (Rate/Noise BW)  Data Rate	3.77E+07	bps/Hz bps
Information Rate (Data + Overhead)	4.00E+07	
Symbol Rate	3.00E+07	
Chip Rate (Noise Bandwidth)	3.00E+07	
Occupied Bandwidth	3.60E+07	Hz
Power Equivelent Bandwidth	5.40E+07	Hz
C/N Threshold	3.5	dB
Uplink		
Frequency	14.090	
Back off EIRP Spectral Density		dB dBW//4kUa
Slant Range	39711	dBW/4kHz
Space Loss, Ls	207.4	
Pointing Loss, Lpnt	0.0	
Atmosphere / Weather Loss, La	3.2	
Radome, Lr	0.0	dB
Transponder G/T @ Hub	7.0	dB/K
Thermal Noise, C/No	97.1	dBHz
C/(No+lo)	96.6	dBHz
Satellite		Interior o
Flux Density		dBW/m2
SFD @ Hub Small Signal Gain (IBO/OBO)		dBW/m2 dB
OBO	0.5	
Downlink	5.5	
Frequency	11.790	GHz
Transponder Sat. EIRP @ Beam Peak		dBW
Transponder Sat. EIRP @ Terminal		dBW
DL PSD Limit		dBW/4kHz
DL PSD @ Beam Peak		dBW/4kHz
Carrier EIRP @ Beam Peak		dBW
Carrier EIRP @ Terminal Slant Range	49.5 38312	dBW km
Space Loss, Ls	205.5	
Pointing Loss, Lpnt		dB
Atmosphere / Weather Loss, La		dB
Radome, Lr	0.5	dB
PCMA Loss		dB
Thermal Noise, C/No	83.2	dBHz
C/(No+lo)	79.5	dBHz
End to End	_, ·	Inu
End to End C/(No+lo)		dBHz
Implementation Loss		dB dB
End to End C/N w/ Imp Loss Link Margin		dB dB
riiiv ividiğili	0.2	uD

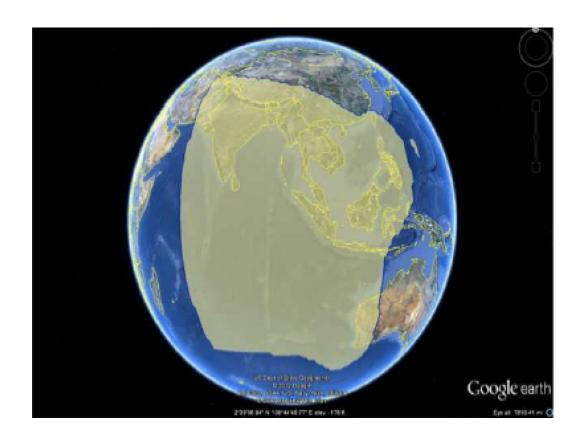
Return Link Budget		
eXConnect Terminal	110120	
Antenna Type Lat	HR129 14.9 des	
Lon	-85.1 de	
EIRP max	41.6 dB	
G/T	11.2 dB,	
Satellite		
Name	Telstar 11N	
Longitude Hub Earth Station	-37.6 deg	3
Site	Cologne	
Lat	50.94 deg	3
Lon	6.96 deg	3
EIRP max	80.0 dB	
G/T	34.4 dB,	/K
Signal	iDirect	
Waveform Modulation	iDirect BPSK	
Bits per symbol	1	
Spread Factor	2	
Coding Rate	0.50	
Overhead Rate	0.74	
Channel Spacing	1.20	
Spectral Efficiency (Rate/Noise BW)	0.18 bps	
Data Rate	1.22E+06 bps	
Information Rate (Data + Overhead)	1.67E+06 bps	5
Symbol Rate Chip Rate (Noise Bandwidth)	3.33E+06 Hz 6.66E+06 Hz	
Occupied Bandwidth	7.99E+06 Hz	
Power Equivelent Bandwidth	2.12E+05 Hz	
C/N Threshold	-2.3 dB	
Uplink		
Frequency	14.029 GH	z
Back off	0.0 dB	
EIRP Spectral Density	9.4 dB'	
Slant Range Space Loss, Ls	38312 km 207.1 dB	
Pointing Loss, Lpnt	0.1 dB	
Atmosphere / Weather Loss, La	0.0 dB	
Radome, Lr	0.5 dB	
Transponder G/T @ Terminal	6.0 dB,	
Thermal Noise, C/No	68.5 dB	
C/(No+lo)	68.0 dB	Hz
Satellite Flux Density	-121.7 dB'	M/m2
SFD @ Terminal	-92.6 dB'	
Small Signal Gain (IBO/OBO)	2.0 dB	,
ОВО	27.1 dB	
Downlink		
Frequency	12.529 GH	
Transponder Sat. EIRP @ Beam Peak	52.0 dB'	
Transponder Sat. EIRP @ Hub DL PSD Limit	52.0 dB' 13.0 dB'	
DL PSD @ Beam Peak	-7.3 dB	
Carrier EIRP @ Beam Peak	24.9 dB	
Carrier EIRP @ Hub	24.9 dB'	W
Slant Range	39711 km	
Space Loss, Ls	206.4 dB	
Pointing Loss, Lpnt	0.0 dB	
Atmosphere / Weather Loss, La	4.0 dB	
Radome, Lr PCMA Loss	0.0 dB 0.0 dB	
Thermal Noise, C/No	0.0 dB 77.5 dB	Нэ
C/(No+lo)	71.7471 dB	
End to End	. 1., 1,1 05	
End to End C/(No+Io)	66.5 dB	Hz
Implementation Loss	0.0 dB	
End to End C/N w/ Imp Loss	-1.7 dB	
Link Margin	0.6 dB	

#### Forward Link Budget

Forward Link B	udget
eXConnect Terminal	
Antenna Type	HR129
Lat	51.0 deg
Lon	-0.1 deg
EIRP max	42.5 dBW
G/T	11.0 dB/K
Satellite	
Name	Telstar 11N
Longitude	-37.6 deg
Hub Earth Station	
Site	Ellenwood
Lat	33.663 deg
Lon	-84.226 deg
EIRP max	90.0 dBW
G/T	40.0 dB/K
Signal	
Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.60
Overhead Rate	0.94
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	1.13 bps/Hz
Data Rate	1.55E+07 bps
Information Rate (Data + Overhead)	1.65E+07 bps
Symbol Rate	1.38E+07 Hz
Chip Rate (Noise Bandwidth)	1.38E+07 Hz
Occupied Bandwidth	1.65E+07 Hz
Power Equivelent Bandwidth	2.70E+07 Hz
C/N Threshold	2.7 dB
Uplink -	40.000.011
Frequency	13.888 GHz 0.3 dB
Back off	54.3 dBW/4kHz
EIRP Spectral Density	·
Slant Range	38879 km
Space Loss, Ls	207.1 dB 0.0 dB
Pointing Loss, Lpnt Atmosphere / Weather Loss, La	5.1 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	-9.0 dB/K
Thermal Noise, C/No	97.1 dBHz
C/(No+lo)	96.6 dBHz
Satellite	30.0 dBHZ
Flux Density	-78.2 dBW/m2
SFD @ Hub	-76.2 dBW/m2
Small Signal Gain (IBO/OBO)	1.0 dB
OBO	1.0 dB
Downlink	2.0 00
Frequency	11.588 GHz
Transponder Sat. EIRP @ Beam Peak	45.8 dBW
Transponder Sat. EIRP @ Terminal	45.0 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	9.4 dBW/4kHz
Carrier EIRP @ Beam Peak	44.8 dBW
Carrier EIRP @ Terminal	44.0 dBW
Slant Range	39369 km
Space Loss, Ls	205.6 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	77.5 dBHz
C/(No+lo)	75.2 dBHz
End to End	. OIE WOLLE
End to End C/(No+Io)	75.2 dBHz
End to End C/(No+lo) Implementation Loss	75.2 dBHz 1.0 dB
End to End C/(No+Io) Implementation Loss End to End C/N w/ Imp Loss	75.2 dBHz 1.0 dB 2.8 dB

Return Link Budget		
eXConnect Terminal	HR129	
Antenna Type		
Lat Lon	51.0 deg -0.1 deg	
EIRP max	42.5 dBW	
G/T	11.0 dB/K	
Satellite	2210 00/11	
Name	Telstar 11N	
Longitude	-37.6 deg	
Hub Earth Station		
Site	Ellenwood	
Lat	33.663 deg	
Lon	-84.226 deg	
EIRP max	90.0 dBW	
G/T	40.0 dB/K	
Signal		
Waveform	iDirect	
Modulation	BPSK	
Bits per symbol	1 4	
Spread Factor Coding Rate	0.50	
_	0.74	
Overhead Rate Channel Spacing	1.20	
Channel Spacing Spectral Efficiency (Rate/Noise BW)	0.09 bps/Hz	
Data Rate	6.13E+05 bps	
Information Rate (Data + Overhead)	8.34E+05 bps	
Symbol Rate	1.67E+06 Hz	
Chip Rate (Noise Bandwidth)	6.67E+06 Hz	
Occupied Bandwidth	8.00E+06 Hz	
Power Equivelent Bandwidth	3.81E+05 Hz	
C/N Threshold	-5.6 dB	
Uplink		
Frequency	14.212 GHz	
Back off	0.0 dB	
EIRP Spectral Density	10.2 dBW/4kHz	
Slant Range	39369 km	
Space Loss, Ls	207.4 dB	
Pointing Loss, Lpnt	0.0 dB	
Atmosphere / Weather Loss, La	0.0 dB	
Radome, Lr	0.5 dB	
Transponder G/T @ Terminal	2.0 dB/K	
Thermal Noise, C/No	65.1 dBHz	
C/(No+lo)	64.6 dBHz	
Satellite	424 O -IDM// 2	
Flux Density	-121.0 dBW/m2	
SFD @ Terminal Small Signal Gain (IBO/OBO)	-94.5 dBW/m2 2.0 dB	
OBO	24.5 dB	
Downlink	24.3 UB	
Frequency	11.912 GHz	
Transponder Sat. EIRP @ Beam Peak	45.8 dBW	
Transponder Sat. EIRP @ Hub	42.0 dBW	
DL PSD Limit	13.0 dBW/4kHz	
DL PSD @ Beam Peak	-10.9 dBW/4kHz	
Carrier EIRP @ Beam Peak	21.3 dBW	
Carrier EIRP @ Hub	17.5 dBW	
Slant Range	38879 km	
Space Loss, Ls	205.8 dB	
Pointing Loss, Lpnt	0.0 dB	
Atmosphere / Weather Loss, La	5.9 dB	
Radome, Lr	0.0 dB	
PCMA Loss	0.0 dB	
Thermal Noise, C/No	74.4 dBHz	
C/(No+lo)	71.7265 dBHz	
5) (110 110)	71.7263 UBHZ	
End to End	71.7263 UBHZ	
	63.9 dBHz	
End to End End to End C/(No+lo) Implementation Loss		
End to End End to End C/(No+lo)	63.9 dBHz	

# 17. TELSTAR 12V





Telesat, 1601 Telesat Court Ottawa, ON, Canada K1B 5P4 27 May 2016

Federal Communications Commission International Bureau 445 12<sup>th</sup> Street SW Washington, DC 20554

### Re: Engineering Certification for Astronics AeroSat

To Whom It May Concern:

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Based on the information provided by Astronics AeroSat, Telesat understands the technical characteristics of the HR6400 and HR129 antennas and Telesat (i) recognizes that operation of these terminals at the power density levels provided to Telesat is consistent with the existing coordination agreements with all adjacent satellite operators within +/- 6 degrees of orbital separation from Anik G1, Telstar 12V, and Telstar 11N; (ii) acknowledges that the proposed operation of these terminals has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable; and (iii) if the FCC authorizes the operations proposed by Astronics AeroSat, Telesat will take into consideration the power density levels associated with such operations in all future satellite network coordinations with adjacent satellite operators.

Sincerely,

BAHRAM BORNA

Satellite Spectrum Coordination Engineer

Telesat

## **Link Budgets**

Forward Link Budget		
eXConnect Terminal		
Antenna Type	HR129	
Lat	29.8	-
Lon	45.0	-
EIRP max		dBW
G/T Satellite	10.6	dB/K
Name	T12V	
Longitude	-15.0	deg
Hub Earth Station	10.0	
Site	Mt. Jackson	
Lat	38.103	deg
Lon	-78.064	deg
EIRP max	90.0	dBW
G/T	40.0	dB/K
Signal		
Waveform	DVB-S2	
Modulation	QPSK	
Bits per symbol	2	
Spread Factor	1	
Coding Rate	0.40	
Overhead Rate	0.93	
Channel Spacing	1.20	hns/U-
Spectral Efficiency (Rate/Noise BW) Data Rate	0.74 3.33E+07	bps/Hz
Information Rate (Data + Overhead)	3.60E+07	
Symbol Rate	4.50E+07	
Chip Rate (Noise Bandwidth)	4.50E+07	
Occupied Bandwidth	5.40E+07	
Power Equivelent Bandwidth	4.55E+07	
C/N Threshold	0.2	
Uplink	0.2	
Frequency	29.610	GHz
Back off	8.7	
EIRP Spectral Density	40.8	dBW/4kHz
Slant Range	40335	km
Space Loss, Ls	214.0	dB
Pointing Loss, Lpnt	0.0	dB
Atmosphere / Weather Loss, La	22.9	dB
Radome, Lr	0.0	
Transponder G/T @ Hub	18.2	dB/K
Thermal Noise, C/No		dBHz
C/(No+lo)	90.7	dBHz
Satellite		
Flux Density		dBW/m2
SFD @ Hub		dBW/m2
Small Signal Gain (IBO/OBO)	1.1	
OBO	7.8	dB
Downlink	11 120	CII-
Frequency	11.138	
Transponder Sat. EIRP @ Beam Peak Transponder Sat. EIRP @ Terminal		dBW dBW
DL PSD Limit		dBW/4kHz
DL PSD @ Beam Peak		dBW/4kHz
Carrier EIRP @ Beam Peak		dBW/4kmz
Carrier EIRP @ Terminal		dBW
Slant Range	39817	
Space Loss, Ls	205.4	
Pointing Loss, Lpnt	0.0	
Atmosphere / Weather Loss, La	0.0	
Radome, Lr	0.5	
PCMA Loss	0.0	
Thermal Noise, C/No		dBHz
C/(No+lo)		dBHz
End to End	, 3.0	
End to End C/(No+lo)	78.3	dBHz
Implementation Loss	1.0	
End to End C/N w/ Imp Loss	0.8	
Link Margin	0.6	

0.8 dB 0.6 dB

Link Margin

### Return Link Budget

Return Link Budget		
eXConnect Terminal Antenna Type	HR129	
Lat	29.8	doa
Lon	45.0	-
EIRP max		dBW
G/T		dB/K
Satellite	10.0	ub/ K
Name	T12V	
Longitude	-15.0	deg
Hub Earth Station		
Site	Mt. Jackson	
Lat	38.103	-
Lon	-78.064	-
EIRP max		dBW
G/T	40.0	dB/K
Signal Waveform	iDirect	
Modulation	iDirect BPSK	
Bits per symbol	1	
Spread Factor	1	
Coding Rate	0.67	
Overhead Rate	0.77	
Channel Spacing	1.20	
Spectral Efficiency (Rate/Noise BW)		bps/Hz
Data Rate	3.43E+06	
Information Rate (Data + Overhead)	4.45E+06	bps
Symbol Rate	6.67E+06	Hz
Chip Rate (Noise Bandwidth)	6.67E+06	Hz
Occupied Bandwidth	8.00E+06	Hz
Power Equivelent Bandwidth	1.71E+06	
C/N Threshold	2.4	dB
Uplink	11100	
Frequency Back off	14.188 0.0	
		dBW/4kHz
EIRP Spectral Density Slant Range	39817	
Space Loss, Ls	207.5	
Pointing Loss, Lpnt	0.1	
Atmosphere / Weather Loss, La	0.0	
Radome, Lr	0.5	
Transponder G/T @ Terminal	10.8	dB/K
Thermal Noise, C/No	73.3	dBHz
C/(No+lo)	72.8	dBHz
Satellite		
Flux Density	-121.6	dBW/m2
SFD @ Terminal		dBW/m2
Small Signal Gain (IBO/OBO)	2.0	
OBO	30.8	dB
Downlink	10.400	CU-
Frequency	18.488	
Transponder Sat. EIRP @ Beam Peak		dBW
Transponder Sat. EIRP @ Hub DL PSD Limit		dBW/4kHz
DL PSD @ Beam Peak		dBW/4kHz dBW/4kHz
Carrier EIRP @ Beam Peak		dBW/4KHZ
Carrier EIRP @ Hub	32.8	10111
Slant Range	40335	
	.0000	
Space Loss, Ls	209 9	
	209.9 0.0	
Pointing Loss, Lpnt		dB
Pointing Loss, Lpnt Atmosphere / Weather Loss, La	0.0	dB dB
Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr	0.0 13.5	dB dB dB
Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr PCMA Loss	0.0 13.5 0.0 0.0	dB dB dB
Space Loss, Ls Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+lo)	0.0 13.5 0.0 0.0	dB dB dB dB dBHz
Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No	0.0 13.5 0.0 0.0 78.0	dB dB dB dB dBHz
Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+lo) End to End End to End C/(No+lo)	0.0 13.5 0.0 0.0 78.0 76.6984	dB dB dB dB dBHz dBHz
Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+Io) End to End End to End C/(No+Io) Implementation Loss	0.0 13.5 0.0 0.0 78.0 76.6984 71.3 0.0	dB dB dB dB dBHz dBHz dBHz
Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+lo) End to End End to End C/(No+lo)	0.0 13.5 0.0 0.0 78.0 76.6984	dB dB dB dB dBHz dBHz dBHz dB

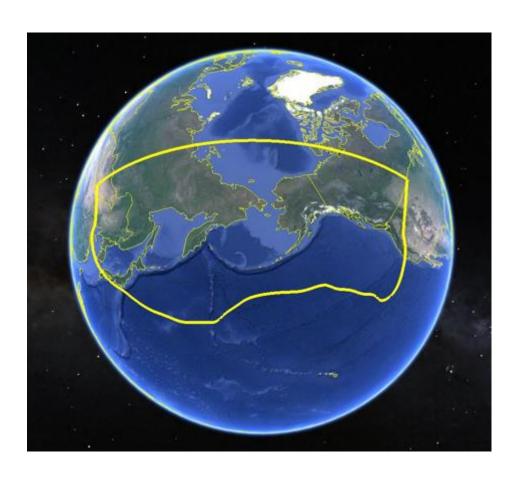
Forward Link B	udget	Return Link Bud	dget
eXConnect Terminal		eXConnect Terminal	
Antenna Type	HR6400	Antenna Type	HR6400
Lat	29.8 deg	Lat	29.8 deg
Lon	42.0 deg	Lon	42.0 deg
EIRP max	45.5 dBW	EIRP max	45.5 dBW
G/T	10.0 dB/K	G/T	10.0 dB/K
Satellite	10.0 db/K	Satellite	10.0 db/ K
Name	T12V	Name	T12V
Longitude	-15.0 deg	Longitude	-15.0 deg
Hub Earth Station	-15.0 deg	Hub Earth Station	-13.0 deg
Site	Mt. Jackson	Site	Mt. Jackson
_at	38.746 deg	Lat	38.746 deg
Lon	-78.653 deg	Lon	-78.653 deg
EIRP max	_	EIRP max	<del>-</del>
	90.0 dBW		90.0 dBW 39.0 dB/K
G/T	39.0 dB/K	G/T	39.U dB/K
Signal	D1/D 00	Signal	· .
Waveform	DVB-S2	Waveform	iDirect
Modulation	QPSK	Modulation	QPSK
Bits per symbol	2	Bits per symbol	2
pread Factor	1	Spread Factor	1
Coding Rate	0.60	Coding Rate	0.67
Overhead Rate	0.94	Overhead Rate	0.85
Channel Spacing	1.20	Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	1.13 bps/Hz	Spectral Efficiency (Rate/Noise BW)	1.13 bps/Hz
Data Rate	4.37E+07 bps	Data Rate	7.54E+06 bps
nformation Rate (Data + Overhead)	4.65E+07 bps	Information Rate (Data + Overhead)	8.89E+06 bps
Symbol Rate	3.88E+07 Hz	Symbol Rate	6.67E+06 Hz
Chip Rate (Noise Bandwidth)	3.88E+07 Hz	Chip Rate (Noise Bandwidth)	6.67E+06 Hz
Occupied Bandwidth	4.65E+07 Hz	Occupied Bandwidth	8.00E+06 Hz
Power Equivelent Bandwidth	3.92E+07 Hz	Power Equivelent Bandwidth	2.68E+06 Hz
C/N Threshold	2.7 dB	C/N Threshold	5.0 dB
Uplink		Uplink	***************************************
requency	29.810 GHz	Frequency	14.188 GHz
Back off	10.0 dB	Back off	2.6 dB
EIRP Spectral Density	40.2 dBW/4kHz	EIRP Spectral Density	10.7 dBW/4kH
Slant Range	40403 km	Slant Range	39554 km
<del>-</del>	214.1 dB	=	207.4 dB
Space Loss, Ls	0.0 dB	Space Loss, Ls	207.4 dB 0.1 dB
Pointing Loss, Lpnt		Pointing Loss, Lpnt	
Atmosphere / Weather Loss, La	22.3 dB	Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB	Radome, Lr	0.5 dB
Fransponder G/T @ Hub	18.2 dB/K	Transponder G/T @ Terminal	11.8 dB/K
Thermal Noise, C/No	90.5 dBHz	Thermal Noise, C/No	75.3 dBHz
C/(No+lo)	90.0 dBHz	C/(No+Io)	74.8 dBHz
atellite		Satellite	
Flux Density	-105.3 dBW/m2	Flux Density	-120.6 dBW/m2
SFD @ Hub	-95.8 dBW/m2	SFD @ Terminal	-89.8 dBW/m2
imall Signal Gain (IBO/OBO)	1.1 dB	Small Signal Gain (IBO/OBO)	2.0 dB
DBO	8.5 dB	ОВО	28.8 dB
Downlink		Downlink	
requency	11.138 GHz	Frequency	18.488 GHz
ransponder Sat. EIRP @ Beam Peak	59.4 dBW	Transponder Sat. EIRP @ Beam Peak	63.6 dBW
ransponder Sat. EIRP @ Terminal	58.4 dBW	Transponder Sat. EIRP @ Hub	63.6 dBW
DL PSD Limit	11.0 dBW/4kHz	DL PSD Limit	11.0 dBW/4ki
DL PSD @ Beam Peak	11.0 dBW/4kHz	DL PSD @ Beam Peak	2.6 dBW/4kl
Carrier EIRP @ Beam Peak	50.9 dBW	Carrier EIRP @ Beam Peak	34.8 dBW
Carrier EIRP @ Terminal	49.9 dBW	Carrier EIRP @ Hub	34.8 dBW
lant Range	39554 km	Slant Range	40403 km
pace Loss, Ls	205.3 dB	Space Loss, Ls	209.9 dB
Pointing Loss, Lpnt	0.1 dB	Pointing Loss, Lpnt	0.0 dB
9 , ,			12.6 dB
Atmosphere / Weather Loss, La	0.0 dB	Atmosphere / Weather Loss, La	
Radome, Lr	0.5 dB	Radome, Lr	0.0 dB
PCMA Loss	0.0 dB	PCMA Loss	0.0 dB
Thermal Noise, C/No	82.6 dBHz	Thermal Noise, C/No	79.9 dBHz
C/(No+lo)	80.7 dBHz	C/(No+lo)	78.6128 dBHz
ind to End		End to End	
nd to End C/(No+lo)	80.2 dBHz	End to End C/(No+lo)	73.3 dBHz
Implementation Loss	1.0 dB	Implementation Loss	0.0 dB

80.2 dBHz 1.0 dB 3.3 dB 0.6 dB

Implementation Loss End to End C/N w/ Imp Loss Link Margin

Implementation Loss End to End C/N w/ Imp Loss Link Margin 73.3 dBHz 0.0 dB 5.0 dB 0.0 dB

# 18. YAMAL 300K





## ОТКРЫТОЕ АКЦИОНЕРНОЕ ОБЩЕСТВО «ГАЗПРОМ КОСМИЧЕСКИЕ СИСТЕМЫ»

(ОАО «Газпром космические системы»)

а/в 1860, ОПС Щапково-12, Московская область, Российская Федерация, 141112

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28.06.2016

No 1K-06/380/2974

Federal Communications Commission International Bureau 445 12th Street, S.W. Washington, D.C. 20554

Re: Engineering Certification of Gazprom Space Systems.

To Whom It May Concern:

This letter certifies that Gazprom Space Systems ("GSS") is aware that Astronics AeroSat Corporation ("Astronics AeroSat") is planning to seek a modification to its blanket authorization from the Federal Communications Commission ("FCC") to operate technically identical Ku-band transmit/receive earth stations aboard aircraft ("ESAAs"), Call Sign E140087, with the Yamal-401 satellite at 90°E and the Yamal-300K satellite at 183°E. Specifically, we understand that in addition to the previously authorized HR6400 terminals, Astronics AeroSat seeks to operate HR129 terminals with these satellites for commercial purposes consistent with the FCC's ESAA rules, including Section 25.227.

GSS certifies that the proposed operation of the ESAA transmit/receive terminals at the power density levels specified are consistent with coordination agreements with affected satellite networks within +/- 6 degrees of orbital separation from the Yamal-401 and Yamal-300K satellites nominal positions. GSS also acknowledges that the proposed operation of the Astronics AeroSat ESAA terminal has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable. If the FCC authorizes the operations proposed by Astronics AeroSat, GSS will endeavour to ensure that the relevant Administration will include the power density levels specified by Astronics AeroSat in all coordinations with the future satellite networks.

Best regards.

Igor Kot,

Deputy Director General

## **Link Budgets**

### Forward Link Budget

### Flitestream Terminal Site Antenna Type HR6400 46.9 deg 132.0 deg Lat Lon G/T Satellite Name Longitude 11.8 dB/K Yamal-300K 183.0 deg Hub Earth Station Site 48.1 deg -119.8 deg 60.0 dBW Lat Lon EIRP max

Signal	
Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.50000
Overhead Rate	0.83000
Channel Spacing	1.20000
Spectral Efficiency (Rate/Noise BW)	0.83000 bps/Hz
Data Rate	3.74E+07 bps
Information Rate (Data + Overhead)	4.50E+07 bps
Symbol Rate	4.50E+07 Hz
Chip Rate (Noise Bandwidth)	4.50E+07 Hz
Occupied Bandwidth	5.40E+07 Hz
C/N Threshold	0.9 dB

Uplink	
Frequency	14.380000 GHz
Power Control Mode	Automatic Uplink Power Control
Back off	14.2 dB
EIRP Spectral Density	25.3 dBW/4kHz
Slant Range	40298 km
Space Loss, Ls	207.7 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.6 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	4.0 dB/K
Thermal Noise, C/No	87.1 dBHz
C/(No+lo)	86.9 dBHz

Satellite	
Flux Density	-100.5 dBW/m2
SFD @ Hub	-94.5 dBW/m2
Small Signal Gain (IBO/OBO)	3.0 dB
ОВО	3.0 dB

Downlink		
Frequency	11.580000	GHz
Transponder Sat. EIRP @ Beam Peak	53.5	dBW
Transponder Sat. EIRP @ Terminal	52.5	dBW
DL PSD Limit	13.0	dBW/4kHz
DL PSD @ Beam Peak	9.6	dBW/4kHz
Carrier EIRP @ Beam Peak	50.1	dBW
Carrier EIRP @ Terminal	49.1	dBW
Slant Range	39839	km
Space Loss, Ls	205.7	dB
Pointing Loss, Lpnt	0.1	dB
Atmosphere / Weather Loss, La	0.0	dB
Radome, Lr	0.0	dB
PCMA Loss	0.0	dB
Thermal Noise, C/No	83.6	dBHz
C/(No+lo)	83.3	dBHz
End to End	·	·

Ena to Ena	
End to End C/(No+Io)	81.7 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	4.2 dB
Link Margin	3.3 dB

### Return Link Budget (Link 1)

Flitestream Terminal	
Site	
Antenna Type	HR6400
Lat	46.9 deg
Lon	132.0 deg
EIRP max	45.1 dBW
0 . 1111	

Satellite	
Name	Yamal-300K
Longitude	183.0 deg
Hub Earth Station	

Site	
Lat	48.1 deg
Lon	-119.8 deg
G/T	37.5 dB/K
e: 1	

Signal	
Waveform	iDirectRL-SF8
Modulation	BPSK
Bits per symbol	1
Spread Factor	2
Coding Rate	0.67
Overhead Rate	0.72
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.24 bps/Hz
Data Rate	1.61E+06 bps
Information Rate (Data + Overhead)	2.22E+06 bps
Symbol Rate	3.33E+06 Hz
Chip Rate (Noise Bandwidth)	6.67E+06 Hz
Occupied Bandwidth	8.00E+06 Hz
C/N Threshold	-1.2 dB

Uplink	
Frequency	14.380000 GHz
Power Control Mode	Automatic Uplink Power Control
Back off	0.0 dB
EIRP Spectral Density	12.9 dBW/4kHz
Slant Range	39839 km
Space Loss, Ls	207.6 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
Transponder G/T @ Terminal	5.0 dB/K
Thermal Noise, C/No	71.0 dBHz
C/(No+lo)	70.5 dBHz

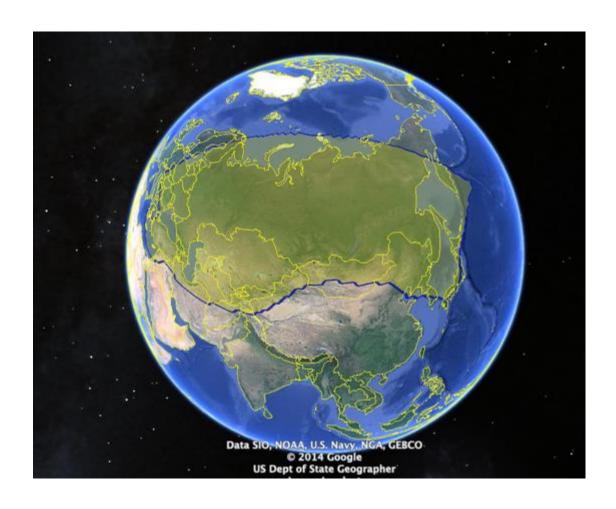
Satellite	
Flux Density	-117.3 dBW/m2
SFD @ Terminal	-95.5 dBW/m2
Small Signal Gain (IBO/OBO)	3.0 dB
ОВО	22.2 dB
December 1	

Downlink	•
Frequency	11.580000 GHz
Transponder Sat. EIRP @ Beam Peak	53.5 dBW
Transponder Sat. EIRP @ Hub	51.5 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	1.8 dBW/4kHz
Carrier EIRP @ Beam Peak	34.0 dBW
Carrier EIRP @ Hub	32.0 dBW
Slant Range	40298 km
Space Loss, Ls	205.8 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.4 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	88.9 dBHz
C/(No+lo)	86.9 dBHz

End to End	
End to End C/(No+Io)	70.4 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	3.2 dB
Link Margin	3.4 dB

Forward Link Budget		Return Link Budget		
eXConnect Terminal		eXConnect Terminal		
Antenna Type	HR129	Antenna Type	HR129	
Lat	47.8 deg	Lat	47.8 deg	
Lon	-128.2 deg	Lon	-128.2 deg	
EIRP max	42.0 dBW	EIRP max	42.0 dBW	
G/T	11.1 dB/K	G/T	11.1 dB/K	
Satellite		Satellite		
Name	Yamal-300K	Name	Yamal-300K	
Longitude	183.0 deg	Longitude	183.0 deg	
Hub Earth Station		Hub Earth Station		
Site	Brewster	Site	Brewster	
Lat	48.1 deg	Lat	48.1 deg	
Lon	-119.8 deg	Lon	-119.8 deg	
EIRP max	80.0 dBW	EIRP max	80.0 dBW	
G/T	36.8 dB/K	G/T	36.8 dB/K	
Signal		Signal		
Waveform	DVB-S2	Waveform	iDirect	
Modulation	8PSK	Modulation	BPSK	
Bits per symbol	3	Bits per symbol	1	
Spread Factor	1	Spread Factor	2	
Coding Rate	0.75	Coding Rate	0.67	
Overhead Rate	0.92	Overhead Rate	0.72	
Channel Spacing	1.20	Channel Spacing	1.20	
Spectral Efficiency (Rate/Noise BW)	2.07 bps/Hz	Spectral Efficiency (Rate/Noise BW)	0.24 bps/Hz	
Data Rate	5.39E+07 bps	Data Rate	1.61E+06 bps	
Information Rate (Data + Overhead)	5.85E+07 bps	Information Rate (Data + Overhead)	2.22E+06 bps	
Symbol Rate	2.60E+07 Hz	Symbol Rate	3.34E+06 Hz	
Chip Rate (Noise Bandwidth)	2.60E+07 Hz	Chip Rate (Noise Bandwidth)	6.67E+06 Hz	
Occupied Bandwidth	3.12E+07 Hz	Occupied Bandwidth	8.00E+06 Hz	
Power Equivelent Bandwidth	6.46E+07 Hz	Power Equivelent Bandwidth	2.46E+05 Hz	
C/N Threshold	8.5 dB	C/N Threshold	-1.2 dB	
Uplink		Uplink		
Frequency	14.380 GHz	Frequency	14.210 GHz	
Back off	5.1 dB	Back off	0.0 dB	
EIRP Spectral Density	36.7 dBW/4kHz	EIRP Spectral Density	9.7 dBW/4kHz	
Slant Range	40299 km	Slant Range	39762 km	
Space Loss, Ls	207.7 dB	Space Loss, Ls	207.5 dB	
Pointing Loss, Lpnt	0.0 dB	Pointing Loss, Lpnt	0.0 dB	
Atmosphere / Weather Loss, La	3.2 dB	Atmosphere / Weather Loss, La	0.0 dB	
Radome, Lr	0.0 dB	Radome, Lr	0.5 dB	
Transponder G/T @ Hub	5.0 dB/K	Transponder G/T @ Terminal	6.5 dB/K	
Thermal Noise, C/No	97.5 dBHz	Thermal Noise, C/No	69.0 dBHz	
C/(No+lo)	97.0 dBHz	C/(No+Io)	68.5 dBHz	
Satellite	37.0 dBH2	Satellite	00.5 45112	
Flux Density	-91.5 dBW/m2	Flux Density	-121.6 dBW/m2	
SFD @ Hub	-87.0 dBW/m2	SFD @ Terminal	-90.9 dBW/m2	
Small Signal Gain (IBO/OBO)	3.0 dB	Small Signal Gain (IBO/OBO)	3.0 dB	
OBO	1.5 dB	OBO	27.7 dB	
Downlink	1.5 db	Downlink	27.7 00	
Frequency	11.580 GHz	Frequency	11.160 GHz	
Transponder Sat. EIRP @ Beam Peak	53.6 dBW	Transponder Sat. EIRP @ Beam Peak	53.6 dBW	
Transponder Sat. EIRP @ Terminal	53.5 dBW	Transponder Sat. EIRP @ Hub	52.0 dBW	
DL PSD Limit	14.0 dBW/4kHz	DL PSD Limit	14.0 dBW/4kHz	
DL PSD @ Beam Peak	14.0 dBW/4kHz	DL PSD CIMIL DL PSD @ Beam Peak	-6.3 dBW/4kHz	
Carrier EIRP @ Beam Peak	52.1 dBW	Carrier EIRP @ Beam Peak	-6.5 dBW/4KHZ 26.0 dBW	
_		_		
Carrier EIRP @ Terminal Slant Range	52.0 dBW	Carrier EIRP @ Hub	24.3 dBW	
9	39762 km	Slant Range	40299 km	
Space Loss, Ls	205.7 dB	Space Loss, Ls	205.5 dB	
Pointing Loss, Lpnt	0.0 dB	Pointing Loss, Lpnt	0.0 dB	
Atmosphere / Weather Loss, La	0.0 dB	Atmosphere / Weather Loss, La	3.3 dB	
Radome, Lr	0.5 dB	Radome, Lr	0.0 dB	
PCMA Loss	0.0 dB	PCMA Loss	0.0 dB	
Thermal Noise, C/No	85.5 dBHz	Thermal Noise, C/No	81.0 dBHz	
C/(No+lo)	84.4 dBHz	C/(No+lo)	73.0394 dBHz	
End to End		End to End	er - t-t-	
End to End C/(No+lo)	84.2 dBHz	End to End C/(No+Io)	67.2 dBHz	
Implementation Loss	1.0 dB	Implementation Loss	0.0 dB	
End to End C/N w/ Imp Loss	9.0 dB	End to End C/N w/ Imp Loss	-1.0 dB	
Link Margin	0.5 dB	Link Margin	0.2 dB	

## 19. YAMAL 401





## ОТКРЫТОЕ АКЦИОНЕРНОЕ ОБЩЕСТВО «ГАЗПРОМ КОСМИЧЕСКИЕ СИСТЕМЫ»

(ОАО «Газпром космические системы»)

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28.06.2016

No 1K-06/380/2974

Federal Communications Commission International Bureau 445 12th Street, S.W. Washington, D.C. 20554

Re: Engineering Certification of Gazprom Space Systems.

To Whom It May Concern:

This letter certifies that Gazprom Space Systems ("GSS") is aware that Astronics AeroSat Corporation ("Astronics AeroSat") is planning to seek a modification to its blanket authorization from the Federal Communications Commission ("FCC") to operate technically identical Ku-band transmit/receive earth stations aboard aircraft ("ESAAs"), Call Sign E140087, with the Yamal-401 satellite at 90°E and the Yamal-300K satellite at 183°E. Specifically, we understand that in addition to the previously authorized HR6400 terminals, Astronics AeroSat seeks to operate HR129 terminals with these satellites for commercial purposes consistent with the FCC's ESAA rules, including Section 25.227.

GSS certifies that the proposed operation of the ESAA transmit/receive terminals at the power density levels specified are consistent with coordination agreements with affected satellite networks within +/- 6 degrees of orbital separation from the Yamal-401 and Yamal-300K satellites nominal positions. GSS also acknowledges that the proposed operation of the Astronics AeroSat ESAA terminal has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable. If the FCC authorizes the operations proposed by Astronics AeroSat, GSS will endeavour to ensure that the relevant Administration will include the power density levels specified by Astronics AeroSat in all coordinations with the future satellite networks.

Best regards,

Igor Kot,
Deputy Director General

## **Link Budgets**

### **Forward Link Budget**

rittestream reminar		
Antenna Type	HR6400	
Lat	50.41	deg
Lon	40.26	deg
G/T	11.42	dB/K
Satellite		
Name	Yamal-401	
Longitude	90.00	deg
Hub Earth Station		
Site	Moscow	
Lat	55.80	deg
Lon	37.60	deg
EIRP max	73.83	dBW
Signal		
Waveform	DVB-S2	
Modulation	QPSK	
Bits per symbol	2	
Spread Factor	1	
Coding Rate	0.60	
Overhead Rate	0.94	
Channel Spacing	1.20	
Spectral Efficiency (Rate/Noise BW)	1.13	bps/Hz
Data Rate	5.08E+07	bps
Information Rate (Data + Overhead)	5.40E+07	bps
Symbol Rate	4.50E+07	Hz
Chip Rate (Noise Bandwidth)	4.50E+07	Hz
Occupied Bandwidth	5.40E+07	Hz
C/N Threshold	2.7	dB
Uplink		
Frequency	14.180	GHz
Back off	4.6	dB
EIRP Spectral Density	28.7	dBW/4kH
Slant Range	40423	km
Space Loss, Ls	207.61	dB
Pointing Loss, Lpnt	0.0	dB
Atmosphere / Weather Loss, La	4.55	dB
Radome, Lr	0.0	dB
Transponder G/T @ Hub	4.50	dB/K
Thermal Noise, C/No	90.19	dBHz
C/(No+lo)	90.03	dBHz
Satellite		
Flux Density	-98.5	dBW/m2
SFD @ Hub	-92.5	dBW/m2
Small Signal Gain (IBO/OBO)	3.0	dB

ОВО	3.0 dB
Downlink	
Frequency	11.130 GHz
Transponder Sat. EIRP @ Beam Peak	52.1 dBW
Transponder Sat. EIRP @ Terminal	51.5 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	8.7 dBW/4kHz
Carrier EIRP @ Beam Peak	49.2 dBW
Carrier EIRP @ Terminal	48.6 dBW
Slant Range	39962 km
Space Loss, Ls	205.4 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
Thermal Noise, C/No	83.1 dBHz
C/(No+lo)	82.1 dBHz
End to End	
End to End C/(No+lo)	81.5 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	4.0 dB
Link Margin	1.3 dB

## **Return Link Budget**

Flitestream Terminal	
Antenna Type	HR6400
Lat	50.4 deg
Lon	40.3 deg
EIRP max	45.0 dBW

Satellite	
Name	Yamal-401
Longitude	90.0 deg
Hub Earth Station	

nub cartii Station	
Site	Moscow
Lat	55.8 deg
Lon G/T	37.6 deg
G/T	31.7 dB/K

Signal	
Waveform	iDirect
Modulation	BPSK
Bits per symbol	1
Spread Factor	2
Coding Rate	0.67
Overhead Rate	0.72
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.24 bps/Hz
Data Rate	1.61E+06 bps
Information Rate (Data + Overhead)	2.22E+06 bps
Symbol Rate	3.33E+06 Hz
Chip Rate (Noise Bandwidth)	6.67E+06 Hz
Occupied Bandwidth	8.00E+06 Hz
C/N Threshold	-1.2 dB

Uplink	
Frequency	14.180 GHz
Back off	0.0 dB
EIRP Spectral Density	12.8 dBW/4kHz
Slant Range	39962 km
Space Loss, Ls	207.51 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB
Transponder G/T @ Terminal	5.0 dB/K
Thermal Noise, C/No	71.0 dBHz
C/(No+lo)	70.6 dBHz
Satellite	

Jatemite	
Flux Density	-120.7 dBW/m2
SFD @ Terminal	-93.0 dBW/m2
Small Signal Gain (IBO/OBO)	3.0 dB

OBO	24.7 dB
Downlink	
Frequency	11.130 GHz
Transponder Sat. EIRP @ Beam Peak	52.1 dBW
Transponder Sat. EIRP @ Hub	51.5 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	-2.3 dBW/4kHz
Carrier EIRP @ Beam Peak	30.0 dBW
Carrier EIRP @ Hub	29.4 dBW
Slant Range	40423 km
Space Loss, Ls	205.5 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	4.6 dB
Radome, Lr	0.0 dB
Thermal Noise, C/No	79.6 dBHz
C/(No+lo)	79.5 dBHz
End to End	
- to - t-ffee - t	

End to End	
End to End C/(No+lo)	70.0 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	1.8 dB
Link Margin	3.0 dB

#### Forward Link Budget

Forward Link Budget			
eXConnect Terminal			
Antenna Type	HR129		
Lat	51.8	U	
Lon	34.9		
EIRP max		dBW	
G/T	11.0	dB/K	
Satellite			
Name	Yamal-401		
Longitude	90.0	deg	
Hub Earth Station			
Site	Moscow		
Lat	55.8	-	
Lon	37.6	-	
EIRP max		dBW dB/K	
G/T Signal	30.3	UB/ K	
Waveform	DVB-S2		
Modulation	QPSK		
Bits per symbol	2		
Spread Factor	1		
Coding Rate	0.80		
Overhead Rate	0.92		
Channel Spacing	1.20		
Spectral Efficiency (Rate/Noise BW)		bps/Hz	
Data Rate	2.94E+07		
Information Rate (Data + Overhead)	3.20E+07	•	
Symbol Rate	2.00E+07		
Chip Rate (Noise Bandwidth)	2.00E+07		
Occupied Bandwidth	2.40E+07	Hz	
Power Equivelent Bandwidth	7.20E+07	Hz	
C/N Threshold	5.1	dB	
Uplink			
Frequency	14.380	GHz	
Back off	6.8	dB	
EIRP Spectral Density	36.2	dBW/4kHz	
Slant Range	40424	km	
Space Loss, Ls	207.7	dB	
Pointing Loss, Lpnt	0.0	dB	
Atmosphere / Weather Loss, La	4.8		
Radome, Lr	0.0		
Transponder G/T @ Hub		dB/K	
Thermal Noise, C/No		dBHz	
C/(No+lo)	93.7	dBHz	
Satellite	04.0	IDM// 2	
Flux Density		dBW/m2	
SFD @ Hub	-88.8 3.0	dBW/m2	
Small Signal Gain (IBO/OBO) OBO	3.0		
Downlink	3.0	up	
Frequency	11.580	GHz	
Transponder Sat. EIRP @ Beam Peak		dBW	
Transponder Sat. EIRP @ Terminal		dBW	
DL PSD Limit		dBW/4kHz	
DL PSD @ Beam Peak		dBW/4kHz	
Carrier EIRP @ Beam Peak		dBW	
Carrier EIRP @ Terminal		dBW	
Slant Range	40357		
Space Loss, Ls	205.8		
Pointing Loss, Lpnt	0.0		
Atmosphere / Weather Loss, La	0.0		
Radome, Lr	0.5		
PCMA Loss	0.0		
Thermal Noise, C/No		dBHz	
C/(No+lo)		dBHz	
End to End			
End to End C/(No+lo)	79.1	dBHz	
Implementation Loss	1.0	dB	
End to End C/N w/ Imp Loss	5.1	dB	
Link Margin	0.0	dB	

#### Return Link Budget

eXCo:	nnect '	Termi	inal

Antenna Type	HR129
Lat	51.8 deg
Lon	34.9 deg
EIRP max	42.0 dBW
G/T	11.0 dB/K

### Satellite

Name	Yamal-401
Longitude	90.0 deg

### Hub Earth Station

Site	Moscow
Lat	55.8 deg
Lon	37.6 deg
EIRP max	80.0 dBW
G/T	38.5 dB/K

#### Signal

Jigilai	
Waveform	iDirect
Modulation	BPSK
Bits per symbol	1
Spread Factor	4
Coding Rate	0.67
Overhead Rate	0.72
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.12 bps/Hz
Data Rate	8.05E+05 bps
Information Rate (Data + Overhead)	1.11E+06 bps
Symbol Rate	1.67E+06 Hz
Chip Rate (Noise Bandwidth)	6.67E+06 Hz
Occupied Bandwidth	8.00E+06 Hz
Power Equivelent Bandwidth	1.54E+05 Hz
C/N Threshold	-4.2 dB

## C/N Threshold Uplink

Frequency	14.460 GHz
Back off	0.0 dB
EIRP Spectral Density	9.7 dBW/4kHz
Slant Range	40357 km
Space Loss, Ls	207.8 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
Transponder G/T @ Terminal	5.0 dB/K
Thermal Noise, C/No	67.3 dBHz
C/(No+lo)	66.8 dBHz

### Satellite

Flux Density	-121.7 dBW/m2
SFD @ Terminal	-89.0 dBW/m2
Small Signal Gain (IBO/OBO)	3.0 dB
OBO	29.7 dB

## Downlink

Frequency	11.660 GHz
Transponder Sat. EIRP @ Beam Peak	52.1 dBW
Transponder Sat. EIRP @ Hub	51.5 dBW
DL PSD Limit	14.2 dBW/4kHz
DL PSD @ Beam Peak	-9.8 dBW/4kHz
Carrier EIRP @ Beam Peak	22.4 dBW
Carrier EIRP @ Hub	21.8 dBW
Slant Range	40424 km
Space Loss, Ls	205.9 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	5.2 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	77.8 dBHz
C/(No+lo)	70.7777 dBHz

## C/(No+lo) End to End

5.1 dB 0.0 dB

Link Margin

End to End C/(No+lo)	65.3 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	-2.9 dB
Link Margin	1 3 dB